China International Fair for Trade in Services 2021

Engineering Innovations for Sustainable Development Best Practices

World Federation of Engineering Organizations (WFEO)

Guiding Institution

World Federation of Engineering Organizations (WFEO)

Drafting Institution

WFEO China Committee
WFEO Committee on Engineering for Innovative Technologies (CEIT)

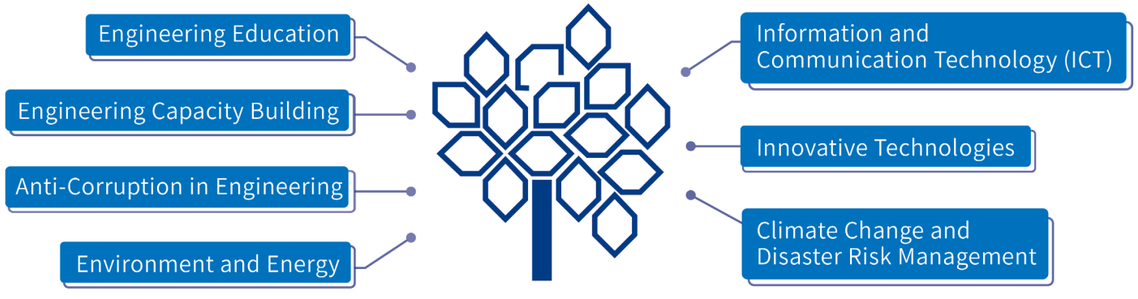
World Federation of Engineering Organizations

World Federation of Engineering Organizations (WFEO) is the largest engineering organization in the world and a union of national and regional engineering institutions. Founded in 1968, under the auspices of UNESCO, WFEO brings together engineering institutions from over 100 nations and regions, representing more than 30 million engineers.

WFEO represents the global engineering profession in joining the Scientific and Technological Community Major Group (STC MG) with the International Council for Science (ICSU). WFEO serves as a major consulting institution for the United Nations Commission on Sustainable Development (CSD) and Economic and Social Council (ECOSOC) as well as the A-level consulting agency for UNESCO.

WFEO focuses on education in engineering, engineering capacity building, anti-corruption, environment and energy, information and communication technology, innovative technologies, climate change, and disaster risk management etc. It carries out wide cooperation with the United Nations and other international organizations in science and technology and engineering, devoting to advancing the delivery of the UN SDGs through engineering.

Issues in focus



China International Fair for Trade in Services 2021

CIFTIS is the largest comprehensive exhibition in the field of global trade in services and the leading exhibition in the field of trade in services in China, which has become one of the three major exhibition platforms for China's opening-up together with China Import and Export Fair (Canton Fair) and China International Import Expo (CIIE).

CIFTIS (including the former Beijing Fair) has been successfully held for six sessions, which has become an important platform for spreading ideas, connecting supply and demand, sharing business opportunities, and promoting common development in the field of international trade in services. It brings together the advantage of resources in global trade in services and provides a new platform for governments, international organizations, global service trade enterprises and institutions to display their new achievements and advantages in service trade, and contributes to empowering the development of the industry.

CIFTIS 2021 will be held in China National Convention Center and Shougang Park in Beijing from September 2nd to 7th. With the theme as "Digital Technology Opens the Future and Services Promote Development", CIFTIS 2021 will set up an exhibition zone of around 130,000 square meters and launch over 100 forums and promotion and negotiation activities.

Shougang Park

Over **100** forums and promotion and negotiation activities

An exhibition zone of **130,000** square meters

Contents

China International Fair for Trade in Services 2021

Innovative Engineering Cases Promoting Sustainable Development

PREFACE

Engineering is the knowledge and practice of solving problems. For thousands of years, engineering has evolved with human development as a profession and discipline. Engineering helps human beings meet the production needs of daily problems by using scientific knowledge, technical methods, design and management principles. Engineering includes a series of specific disciplines. In fact, it has become the main driver to help mankind live on the earth and improve the quality of human life. It helps mankind tide over disasters, face public health challenges, ensure food safety and water resources safety, develop communication and transportation, innovate and create new products and services. Engineering solutions are needed where there are problems.

The primary problem facing the world today is to maintain human development and protect the earth. In 2015, at the 70th United Nations General Assembly, countries all over the world unanimously adopted Transforming our World:The 2030 Agenda for Sustainable Development. This new agenda is an ambitious blueprint aiming at building a peaceful and prosperous future and a healthy planet for all. The agenda sets 17 Sustainable Development Goals (SDGs) and 169 specific targets from the social, economic and environmental levels. These goals are based on the Millennium Development Goals and seek to mobilize countries to take action in areas vital to mankind and the earth in the next 15 years. To achieve the SDGs, we need to mitigate and adapt to climate change, build dynamic infrastructure, ensure food supply and nutrition, provide clean and cheap energy and water resource, and protect and restore terrestrial and underwater biodiversity.

Engineering science and technology play an important role in achieving the SDGs. In 2018, UN Secretary General António Guterres wrote a congratulatory letter to the 50th anniversary of the founding of the World Federation of Engineering Organizations, saying: “We strive to achieve 17 sustainable development goals - a world blueprint: build a peaceful and prosperous future for all on a healthy planet. Each of these goals requires solutions rooted in science, technology and engineering.” Human beings must recognize the role of engineering science and technology in achieving the SDGs, because it is engineering science and technology that establish the factual basis, foresee the future, and find the way to realize sustainable change; Engineering science and technology is also a lever to comprehensively promote the realization of the SDGs.

Since 2015, although mankind has made some progress in promoting the realization of the SDGs. Generally, global actions have not been carried out at the needed speed and scale. Now there is only ten years left before the deadline for realizing the 2030 commitment. Therefore, the decade from 2021 to 2030 is also known as the “Decade of Action” and “Ten Years to Transform Our World”. In this decade, engineering innovative solutions have become particularly important as an accelerator to promote the realization of the SDGs.

On the occasion of the China International Fair for Trade in Services 2021, the World Federation of Engineering Organizations solicited innovative engineering cases promoting sustainable development from all parties, and selected some excellent works in order to publicize the important role of engineering practices in promoting the realization of the SDGs, display the practical achievements of engineering innovations promoting sustainable development, and provide useful references for accelerating the realization of the SDGs. This casebook brings together the wisdom and voice of the engineering community, hoping to enhance the public’ s awareness of the role of engineering innovations in promoting the accomplishment of the SDGs, call for more stakeholders to emphasize, innovate and improve engineering, thus making engineering innovations a driving force for mankind and the earth to move towards the road of sustainable development!

— the Editing Group

1 NO POVERTY

· Digital Technology Empowers Targeted Poverty Alleviation to Continue Rural Vitalization

Digital Technology Empowers Targeted Poverty Alleviation to Continue Rural Vitalization

Accumulus (Tianjin) Sharing Economy Information Consulting Co., Ltd.

1 NO POVERTY

Background

Accumulus (Tianjin) Sharing Economy Information Consulting Co., Ltd. ("Accumulus" for short), established in Tianjin in August 2016, provides services such as instant approval, business subcontracting, income settlement, intelligent tax filing, and insurance payment for more than 8,100 platform companies and over 55 million self-employed operators in China, with the vision of "insisting on digital technology empowerment, working together with 600 million Chinese who are in urgent need of development, and fully displaying the talents to achieve common prosperity". Among the self-employed operator customers of Accumulus, 12.698 million people come from the formerly known national poverty-stricken counties, and 2.182 million poor households have been lifted out of poverty, filed and registered. In the past five years after its establishment, Accumulus' various economic indicators have been uplifted by 40 times, and it achieved the revenue of RMB 38.455 billion Yuan and tax payment of RMB 2.468 billion Yuan in 2020, ranking the 261st among top 500 non-state-owned enterprises in China. Accumulus has invested a total of 150 million Yuan in the fight against poverty.

Innovative Practices

(1)Giving Full Play to the Advantages of Main Business to Build the Main Battlefield for Poverty Alleviation

Accumulus provides those who are working hard such as the take-away deliverymen, maintenance workers, and cleaning workers with more convenient employment as well as more income. The self-employed operators served by Accumulus are widely distributed in 15 industries such as video production and telemedicine, with more than 60 subdivisions covering 28 occupational types. They are most concerned about whether they could receive income in time, so Accumulus innovated to support the all-platform payment of WeChat, Alipay and more than 630 various banks, including over 400 village banks, to realize 24/7 hours settlement at any time with a second-level arrival rate of 99.9%, reaching the highest single-day processing of 1.65 million orders so that the self-employed can earn money in no time. In the first quarter of last year, Accumulus launched "Online Instant Approval" electronic business license service, allowing self-employed operators to take orders and earn income as soon as possible through contact-free and online processing from approval to license issuance. As an upgrade of "online comprehensive service", Accumulus has opened up technical interfaces with the State Administration of Taxation, Tianjin Municipal Taxation Bureau and the Market Supervision Commission, achieving the one-time information collection with APP, as well as completing the facial recognition authentication for industrial and commercial registration and tax invoicing. The Municipal Public Security Bureau supports the online one-stop engraving of the official seal of individual industrial and commercial households to save a lot of time and effort for citizens.

Figure .1 Yang Hui, Chairman of Accumulus Investigated the Pepper Industry in Tianshui, Gansu (July 2019).

Figure .2 Yang Hui, Chairman of Accumulus Investigated the Poverty Alleviation Industry in Tibet (August 2020).

(2)Assisting in Poverty Alleviation and Helping 12 Villages Being Instructed and Supervised in Pairs

In April 2020, responding to the call of the State Council Poverty Alleviation Office, Accumulus jointly proposed on People's Daily with 30 non-state-owned enterprises and social organizations across the country to mobilize social forces to help poor villages being instructed and supervised in pairs. Among the 46 poverty-stricken villages under the supervision of Tianjin City that were aided by counterparts in Tianjin, Accumulus took the initiative to assist 12 villages (8 in Xinjiang and 4 in Gansu), which are the most stubborn "blockhouses" in the fight against poverty located in underdeveloped areas. The company consulted the secretary of the CPC in the village to determine the assistance plan of "Acting According to Local Conditions, Prioritizing Industries, One Policy for One Village, and Increasing as Needed". Accumulus carries out the infrastructure protection such as the transformation of living facilities and the construction of village party branch positions, and the industrial poverty alleviation including agricultural products processing, livestock breeding as well as consumption alleviation, focusing on "Two Assurances and Three Guarantees", industrial poverty alleviation, donation &consumption poverty alleviation, etc.

Achievements

(1)Providing Better Service Plans for Self-employed Operators

In terms of increasing employment income, Accumulus makes use of digital technology empowerment of the gig economy to provide a large number of flexible employment opportunities. The promotion of "Online Instant Approval" helps needy groups increase their income and realize the transition to self-employment. As for insurance protection, Accumulus explores methods suitable for self-employed operators. It has developed 19 government-industry-university-research cooperation projects with universities such as Nankai University and Tianjin University to demonstrate practical and feasible plans, and actively made suggestions, submitting a total of 17 proposals on the development of gig economy to the National People's Congress, the National Committee of the Chinese People's Political Consultative Conference (CPPCC) and other departments of National Ministries. On June 22, Yang Hui, chairman of Accumulus, reported to Wang Yang, member of the Standing Committee of the Political Bureau of the CPC Central Committee and Chair of the CPPCC National Committee to promote the solution to subsistence insurance of flexible employment. And with the approval of the Supreme People's Court, Accumulus, worked with Tianjin Higher People's Court and Tianjin University jointly hosted the major annual judicial research project of the Supreme People's Court, with the title of "Research on the Legal Relationship between Practitioners and Platform Operators in the Platform Economy Model", which has provided a reference for the country's legislation on new forms of employment.

(2)Preparation of "Accumulus Plan"for Common Prosperity Based on Digital Technology

Accumulus has established a sub-headquarter company in Gannan Tibetan Autonomous Prefecture in Gansu, and implemented a "live broadcast + e-commerce" operation center, turning local ecological advantages of green mountains and clear waters into development advantages. The company attracted more consumers by shooting short videos about the local folk culture and specialty products to help the villagers live a good life, focusing on a dozen kinds of traditional snacks such as Jiangshui noodles(a kind of local noodles), Gua gua(a flour-made snack), San Fan(a wheat-made food), and specialty products such as Huaniu apple, Qinzhou cherry, Qin'an peach, etc. The comparative advantages of ecological products from places with green mountains are shown in an all-round way on popular short-video App platforms such as Tik Tok and Kwai, so as to enhance the attractiveness of poverty alleviation products, and to drive the development of local tourism and culture with the help of network traffic.

Figure .3 Yang Hui, Chairman of Accumulus Investigated the Agaric Breeding Industry in Tibet (October 2020).

Figure .4 Yang Hui, Chairman of Accumulus Investigated the Jujube Breeding Industry in Xinjiang (October 2020).

(3) "One Policy for One Village" to Implement Targeted Poverty Alleviation Measures

Accumulus acts according to local conditions to carry out poverty alleviation in indicated poverty-stricken villages under supervision. In Fuping Village, Gannan Prefecture, Gansu Province, it is suitable to plant cucumbers according to the soil and climate conditions of the village, so the company introduced new varieties from Tianjin Cucumber Research Institute and gave a hand in building sunlight glass greenhouses for new varieties. In 8 villages including Xinjiang Kegazi village, located in Hotan Prefecture, for which special industry assistance plan have been made through research and investigation, Accumulus helps villagers develop Hetian sheep and cow breeding in the forest. The company participates in the purchase of supplies for the disabled and safe drinking water projects in daily life, and builds cultural activity centers and dream bookstores for elementary school in such areas as education and culture.

Enlightenment

Since ancient times, employment has been an important way to ensure income and most importantly livelihood. The form of flexible employment has long existed, turning more "mouth to feed" into "hands to create wealth", and has played a key role in raising income and reducing poverty. The emergence of new technologies, new business and new models have created conditions for large-scale flexible employment. Since 2020, the novel coronavirus pneumonia (COVID-19) epidemic has caused the global health crisis and huge economic suffering, seriously affecting the progress made in poverty eradication. The epidemic has also attracted more attention to "new forms of employment" such as shared employment and flexible employment, showing great vitality, resilience and potential, and playing a role that traditional forms of employment cannot replace. Accumulus provides employment services and guarantees for flexible employees and self-employed individuals through information engineering technology, digital means and empowerment on the cloud. It has also developed a blockchain management platform to transmit data "on the chain" and other technical means, to effectively regulate the compliance and sound development of the industry. This is an innovative practice of engineering technology to help achieve the 1st Goal "No Poverty" of the United Nations 2030 Sustainable Development Goals.

· Development of Monosulfuron, a Special Herbicide for Super Efficient and Eco-friendly Millet

Development of Monosulfuron, a Special Herbicide for Super Efficient and Eco-friendly Millet

College of Chemistry of
Nankai University

Background

Food, population, resources and environment are major issues that the world concerns today. As the basic industry of national economy, agriculture is directly related to the stability and development of the country. In 2011, the Food and Agriculture Organization of the United Nations (FAO) announced that the crop yield was reduced by 30%-40% due to diseases and insect pests. Every year, about 1 billion tons of crops in the world were destroyed by diseases and insect pests. Pesticides played an irreplaceable role in national agricultural modernization.

Pesticides can not only effectively prevent and control diseases and insect pests, but also ensure food security. Its safe use is also very important to control the pollution of agricultural residues and ensure the quality and safety of agricultural products. The special position of pesticides in refined chemical industry chain is an important part of national economy. People often ignore the great contribution of pesticides to social progress by eliminating various vectors (mosquitoes, flies, bedbugs, mice, etc.) to control major social infectious diseases (malaria, cholera, parasites, plague, etc.).

After China's reform and opening up, Yang Shixian, the former president of Nankai University, adhered to the guiding ideology of "prospering economy and developing academics", presided over the research and development of new technologies such as organophosphorus No.32 and No.47, mierust No.1, herbicide No.1, soybean hormone and cypermethrin translocation, etc., and won 85 national, provincial and municipal awards. At that time, China's foundation of producing pesticides was weak, mainly relying on other countries' pesticides. As a few developed countries monopolize the mainstream direction of new pesticide research in the world, whether China, as a populous country in the world, can own green pesticides with independent intellectual property rights is of great significance to its agricultural development and food security.

Innovative Practices

In 1990s, Li Zhengming's team initiated the research on the creation of new sulfonylurea herbicides, and found that the new structural molecules of sulfonylurea containing monosubstituted pyrimidine ring showed excellent efficacy for the first time from basic research. As its structure does not conform to the internationally recognized Levitt structure-activity rule, Li Zhengming's team put forward a new three-point structure-activity rule of sulfonylurea herbicide at the international conference of the United Nations Industrial Development Organization (UNIDO) in 1999, which guided the synthesis of nearly 1,000 new structural molecules, and found that 5 new molecules had super-efficient herbicidal activity. After successfully docking with AHAS target enzyme in collaboration with Professor Duggleby's team from Australia, it was observed that its mechanism of action was different from that of classical sulfonylurea herbicides. Considering the national conditions, #92825 (later called Monosulfuron) was selected. Field experiments showed that its weeding effect was outstanding, but it was ineffective for Setaria viridis. According to the reverse thinking, it was found that #92825 had superior weeding and yield increasing functions for foxtail millet.

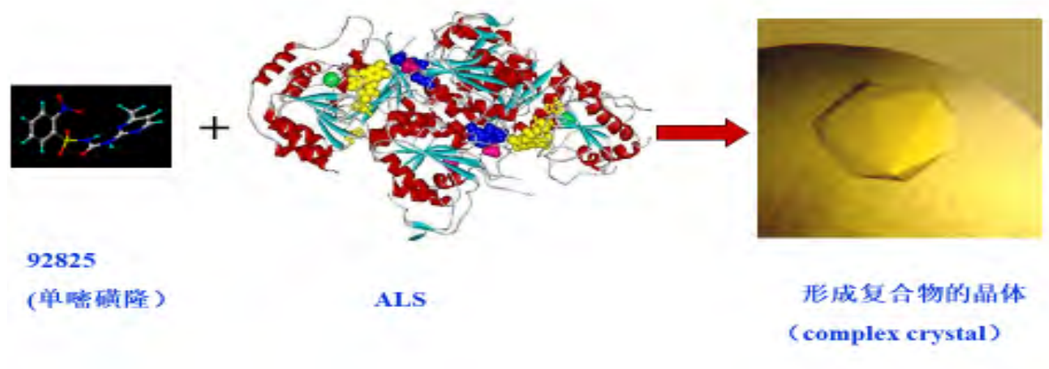


Figure .1 Conducting International Cooperation to Do Basic Research on the Mechanism of Action of New Molecules

Through many years' efficacy tests in small area and field, the weeding effect of Monosulfuron is better than 90% and the application amount is less (2 g/mu). What's more, it is basically non-toxic to warm-blooded animals (LD50 > 4640 mg/kg, which is 25 times lower than the toxicity of toothpaste), and the soil degradation time is short (DT50=5.82 days). The verified millet production in Shandong and Hebei increased by more than 30%. But more importantly, it is found for the first time that Monosulfuron is very safe for rice seedlings and next crops.

In 1949, after the founding of the People's Republic of China, the problems of high-yield improved varieties such as rice, wheat and corn were overcome successively, and various supporting professional herbicides were developed, which finally made the dream of yielding a thousand jin per mu come true. Because of many kinds of weeds and strong vitality, they competed fiercely with crops for sunshine, moisture

and nutrition, which must be strictly controlled, otherwise it would result in a large reduction in production or even no harvest. Therefore, the independent research and development of superior varieties and special herbicides is very important for China’s agricultural high yield and food security. The discovery of special herbicide for millet is undoubtedly of great significance to the development of millet planting industry in China.

It has taken more than 10 years from basic research, patent application, technology development, quality control testing, process development and intermediate test. As a self-made new herbicide, it has to accept the strict examination of 38 basic indicators such as toxicology, environment and ecology by the state. Finally, it has passed all the safety review procedures of the Ministry of Agriculture and obtained three certificates (registration certificate, production certificate and quality inspection certificate) for the country to create new herbicides, achieving the original goal of creating “green pesticides”.

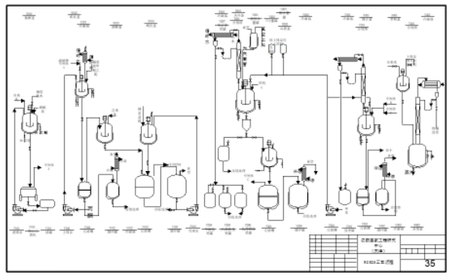


Figure .3 Monosulfuron Process Has Been Transformed into A New Clean Process through Green Chemical Industry

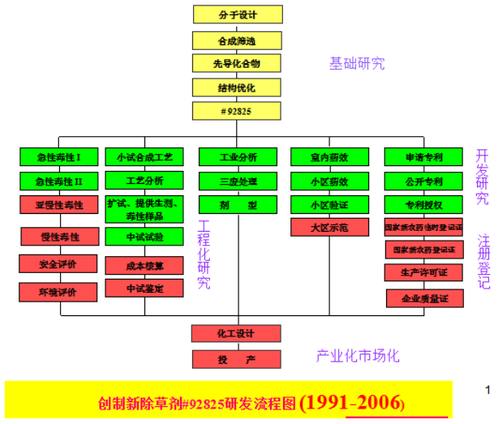


Figure .2 Schematic Diagram of Research Flow of New Herbicide Creation

For the green process improvement of Monosulfuron, the internal circulation system of “Reuse of Production Process Wastewater - Evaporation and Reuse - Crystallization” was designed, and the recycled water was recycled, basically achieving “zero discharge” of waste liquid and wastewater. This green clean process will be industrialized in the cooperative enterprise Xingbai Pesticide Technology Company.

Achievements

Since China’s reform and opening up, the large-scale transfer of rural labor to cities has become a beautiful landscape in the rapid economic development. Due to the important contribution of herbicides to saving a large amount of labor force, agricultural output can still develop steadily in the case of drastic reduction of China’s agricultural labor force,

In recent years, the hybrid millet “Zhangzagu” created by researcher Zhao Zhihai of Zhangjiakou Institute of Agricultural Sciences has increased from 300 jin/mu for many years to 1,000 jin/mu, which is in urgent need of supporting use of professional herbicides. The successful creation of Monosulfuron ensures its large-scale promotion and is known as the “golden partner” in the millet planting industry in China.

The Julu County Committee of Hebei Province once took planting “Zhangzagu” and matching “Monosulfuron” as an effective measure to help the poor accurately, which promoted 300,000 mu in the whole county, increased production by 30 million kg, and increased farmers’ income by 120 million yuan, having the obvious effects of saving water, fertilizer, labor and increasing production. The economic benefits reached twice that of planting corn, thus successfully realizing the poverty alleviation plan of the county.

Monosulfuron (trade name: Guyou) has been demonstrated and popularized in China with a total area of 6 million mu. Taking Hebei Zhihai Agricultural Science and Technology Co., Ltd. as an example, in the past five years, the supporting technology of “Zhangzagu” and “Monosulfuron” has been adopted in 2 million mu of grain fields in Hebei Province. Calculated by increasing production by 250 jin per mu, it has resulted in a cumulative increase of 500 million jin of millet and an economic benefit of over 1 billion yuan.

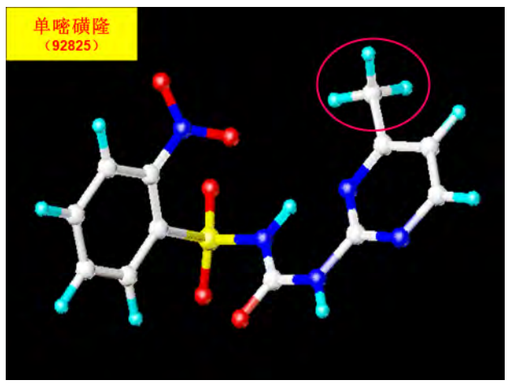


Figure .4 The Candidate New Knot Molecules Found through Layer-by-layer Screening Have Yet to Be Tested for Various Properties

With the strong support of the Chinese government, “Zhangzagu” will be popularized in arid areas of African countries such as Ethiopia, Burkina Faso, Ghana, Kenya, Nigeria, Namibia, Uganda, Sudan, etc., and will be spread together with “Monosulfuron” to the international market.

Enlightenment

Wheat, corn and potato in China are all imported crops from abroad, but millet is a traditional crop with a history of 8000 years in China. Millet has formed the resistance of anti-stress and drought under the condition of severe water shortage and poor soil in China and grows tenaciously, feeding the Chinese nation to multiply for generations. In ancient times, country was called "sheji", while "ji" was millet, and the Chinese people all had special feelings for millet.

In recent years, the excessive use of agricultural water in some areas in northern China has caused the groundwater to drop to the alert level. For example, planting millet can save more than 50% of water, and the nutritional value of millet is recognized again. However, the market price is constantly rising. According to China's agricultural needs, Li Zhengming's team insisted on problem orientation, adopted innovative ideas in line with national conditions and insisted on writing scientific research achievements in China's fields.

Historically, China has copied a large number of foreign high-toxic pesticides with simple technology in the early stage, causing negative impacts on the environment. As early as on the Xiangshan Conference in 2002, Li Zhengming put forward the guiding ideology of "green pesticide creation", which not only protects crops, but also takes social responsibility for environmental safety, ecological balance and the impact of non-target organisms.

Monosulfuron independently created by Li Zhengming's team is the first green herbicide creation achievement with independent intellectual property rights in China, which fills the long-term technical gap of special herbicide for paddy fields at home and abroad, and makes China one of the few countries in the world with the ability to independently create new herbicides after developed countries such as the United States, Germany and Japan.

·Guangzhou Steel Baihedong Block Contaminated Soil Remediation Technical Program

·Graphene Functionalized Antibacterial Composite Materials

·The In-situ Thermal Desorption Remediation Project of Organic Contaminated Site After Relocation of an Industrial Enterprise in Suzhou

Guangzhou Steel Baihedong Block Contaminated Soil Remediation Technical Program

北京建工环境修复股份有限公司
BCEG ENVIRONMENTAL REMEDIATION CO.,LTD.

BCEG Environmental Remediation CO., LTD.

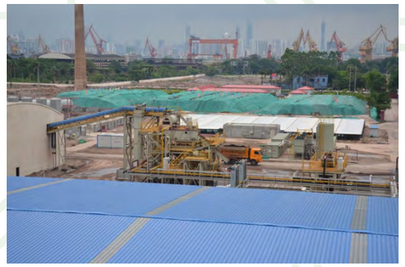


Figure .1 An Overhead View of the Site

3 GOOD HEALTH AND WELL-BEING

Background

Guangzhou Iron and Steel Enterprise Group Co., Ltd. (hereinafter referred to as Guanggang) is a local iron and steel conglomerate engaged in multiple fields including ferrous metallurgy and rolling processing, logistics, E-commerce, gas industry, etc. Guangzhou Municipal Government has incorporated the Guanggang Baihedong site in the planning scope of the "Guanggang New City", which will be built into a high-standard residential district.

According to Circular on Solid Efforts for Environmental Pollution Prevention During Corporate Relocation (HUANBAN [2004] 47#) issued by the former SEPA (State Environmental Protection Administration) , the Opinions on More Efforts for Soil Pollution Prevention (HUANFA [2008] 48#) issued by the Ministry of Environmental Protection, the State Council's Opinions on Facilitating Critical Efforts for Environmental Protection (GUOFA [2011] 35#) issued by the State Council, Circular on Ensuring Environmental Safety during Redevelopment and Utilization of Previous Industrial and Corporate Premises (HUANFA [2012] 140#) issued by the Ministry of Environmental Protection and other documents, "If the original site of an industrial enterprise is shut down, transferred, bankrupted, or relocated, the site investigation and risk assessment shall be completed before the transfer of the land." "If the site is defined as a contaminated site after the site investigation and risk assessment, the responsibility for remediation shall be clearly defined and the liability subject shall prepare a remediation plan." "When the remediation of the contaminated site is completed and the environmental requirements have been met, the site can be put into use." The Baihedong Production Base has been engaged in steel smelting production for a long time. The investigation results showed that the soil of the Baihedong Production Base was contaminated by heavy metals and polycyclic aromatic hydrocarbons. The total area of contaminated soil is 157,858 m^2, and the total amount of contaminated soil is 517,591 m^3. It is necessary to carry out the remediation project of contaminated soil. BCEG Environmental Remediation CO., LTD. (BCEER) won the bid for the restoration project. After more than one year of site remediation, the project was completed by the end of November, 2016 and passed the acceptance review.

Innovative Practices

The project department of our company organized personnel, materials and machinery to enter the site on August 10th, 2015. Based on the equipment entry plan, construction preparations were carried out, including three connections and one leveling, functional area design, facility and equipment construction, etc. The main construction preparation was completed on January 14th, 2016. The specific construction processes of this project are as follows.

(1)Construction Preparation

At the construction preparation stage, firstly, the project management system was established. The large-scale professional restoration equipment, conventional machinery that ensured the connection of various processes and various on-site test instruments and equipment were arranged in an orderly manner to enter the site. The equipment and materials were installed, debugged and classified according to the general layout confirmed by the construction unit and supervising unit.

(2)Excavation and Transfer of Contaminated Soil

333,385 m^3 contaminated soil in the northern area of the site was excavated and stored in the temporary membrane-structured storage on site before the project started. After the preparations of construction, a total of 187,028 m^3 contaminated soil was excavated in the southern area from August 2015 to October 2016. The contaminated soil was transported to the remediation workshops based on the contaminated soil type. Secondary pollution was strictly avoided in the whole process of excavation and transportation of the contaminated soil.

Figure .2 Soil Elution Process

Figure .3 Solidification and Stabilization Process

(3) Remediation of Contaminated Soil

The remediation process of the contaminated soil is soil excavation, transfer, temporary storage → crushing and screening pretreatment → soil washing → ex-situ thermal desorption → solidification and stabilization → backfilling.

(4) Backfilling

With the acceptance of qualified soil by the Guangzhou Environmental Monitoring Center Station and the approval of the construction unit, 470,328 m^3 of clean material was backfilled into the foundation pit in the southern area that has passed the acceptance inspection. 99,966 m^3 of stabilized soil was backfilled in the heavy metal backfill area with risk management conducted. The heavy metal backfill area was constructed and managed strictly in accordance with the risk control requirements. Long-term monitoring of groundwater was carried out to ensure that the risk of the backfill area is controllable.

(5) Quality Control and Secondary Pollution Prevention

During the construction period, the project was conducted strictly according to the quality management system, and secondary pollution prevention measures were implemented consistent with the recorded implementation plan to ensure that the construction process did not cause any secondary pollution.

Achievements

Due to the imperfection and backwardness of the production processes in the past, most production companies inevitably ignored environment protection and secondary pollution prevention in the production process, resulting in water pollution, noise pollution and soil pollution in the plant area. Nowadays, with the renewal of people's environmental protection concepts, the pollution caused by old production companies has gradually come into the public view. Environmental emergencies and complaints caused by soil pollution have emerged one after another. Therefore, it is a pressing and crucial issue to restore the soil contamination of old factories and ensure the sustainable development of the soil environment at present.

The successful completion of the project is of great significance to the sustainable development of the pollution remediation industry. This project has promotion and demonstration value and has provided guidance for the development of the soil remediation industry and implementation of site remediation projects in the future nationwide.

The main achievements obtained during the construction process are as follows:

(1) During the execution of the project, the engineers solved various technical problems through continuous exploration and accumulation, and independently developed multiple sets of soil remediation equipment and systems. A number of utility model patents and innovative applications have been obtained and relevant standards have been improved, filling the gaps in the field of soil remediation. Therefore, the combination of production, teaching and research has been achieved.

(2) During the implementation of this project, the management team created a series of unique management achievements applicable to environmental projects. It has laid a good management foundation for the successful implementation of the projects.

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Enlightenment

This case was a remediation project with the largest single contract value in the field of soil remediation at that time. After more than one year of exploration and innovation, a complete system for soil remediation projects has been established, which will provide guidance to the similar projects in the future. It has provided and restored the land ecological system, and contained the land deterioration.

The successful construction experience, project management experience and innovation experience summarized are all reproducible and have good promotion and demonstration value for the soil remediation industry.

Through the exploration and summary of the management team, we have put forward an innovative combination of multiple techniques to remove complex and diverse pollutants and achieved the desired goals. The habitability of "Guanggang New City" has been enhanced, which accelerated the transformation of old cities and city upgrades and led to the improvement of people's well-being.

Graphene Functionalized Antibacterial Composite Materials

北京石墨烯技术研究院
Beijing Institute of Graphene Technology

Beijing Institute of Graphene Technology

3 GOOD HEALTH AND WELL-BEING

Background

Since the COVID-19 pandemic, the spread of the virus through international flights has led to repeated outbreaks around the world. Civil aircraft cabin interiors' antimicrobial capabilities have attracted great attention from all parties in the aviation industry chain.

As a typical high-density semi-enclosed space, the aircraft cabin may not only cause infection of passengers and the crew during the epidemic period, but also aggravate the risk of infectious diseases' rapid spread in regions and different countries. There are three main ways of spreading bacteria and viruses in the aircraft cabin: air transmission, close contact transmission (including close air transmission, direct inhalation of droplets and deposits of inhalable droplets on the human mucosa), surface contact transmission (including the process of food and water supply, surface contact and use of the bathroom, etc.), surface contact transmission accounted for the highest proportion, more than 50%. Passengers that carry viruses and germs contacting aircraft cabin parts will cause a large number of pathogens to remain on the surface of the chairs, fabrics, dining tables, toilets, and other interior surfaces or crevices in cabins, which have become a long-term pollution source. The development of cabin interiors with sterilization functions and antibacterial therefore is of great significance.

Innovative Practices

Since 2010, graphene has been used for fabricating antimicrobial materials. Researchers in Nanyang Technological University (Singapore) has systematically studied the intrinsic antibacterial properties of graphene and its derivatives, among which graphene oxide has the best antibacterial properties. The Shanghai Institute of Applied Physics, Chinese Academy of Sciences reported the antibacterial properties of graphene oxide, and the sterilization effect reached 98.5% within 2 hours. Huazhong Agricultural University has also reported the antiviral properties of graphene oxide. At a low concentration of only 1.5mg/L, graphene oxide can kill 95% of viruses within 1 hour. In addition to pure graphene materials, graphene loaded silver, copper, titanium dioxide and other composite antibacterial materials also show better antibacterial effects. The South Korean Global Desalination Research Center and the National University of Singapore have respectfully studied the antibacterial properties of graphene-loaded silver and copper, and both exhibited more than 98% of the antibacterial properties. Graphene has the advantages of no volatilization and no loss, and has long-term antibacterial ability.

Beijing Institute of Graphene Technology has developed graphene functionalized antibacterial composite materials such as polyethylene, polypropylene, and epoxy resin. Among them, the graphene polyethylene antibacterial film has an antibacterial rate of over 99.99% against Escherichia coli and Staphylococcus aureus, and the number of colonies can be reduced from 6.9 billion to less than 1,000; the graphene polypropylene composite material meltblown cloth has an effect on the coronavirus (HCoV-229E). The effective rate reaches 99.2%. Graphene epoxy resin and polycarbonate materials have been developed. The antibacterial efficiency against Escherichia coli and Staphylococcus aureus is beyond 99.9%.

In response to the demand for improving the antimicrobial capabilities of the existing civil aircraft

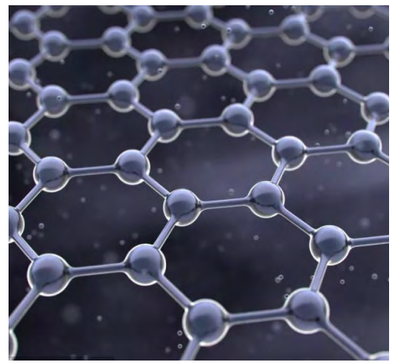


Figure .1 Graphene

without replacing the cabin interiors, the graphene-based antibacterial coating has been developed. The graphene-based coating can be sprayed on the dining table, kitchen, and bathroom facilities, and equip the existing internal facilities of the cabin with a long-term antibacterial competence. The antibacterial efficiency against Escherichia coli, Staphylococcus aureus, and Candida albicans exceeds 99.5%.

Based on previous researches, Beijing Institute of Graphene Technology and COMAC Beijing Civil Aircraft Technology Research Center have jointly developed a series of graphene cabin antibacterial interiors, including dining table, side wall panel, seat armrest, antibacterial blanket, long-term antibacterial coating and so on.

Figure .2 The Dining Table

Achievements

Graphene antibacterial interiors have greatly improved the antimicrobial capabilities on the basis of meeting the requirements of existing aircraft interiors materials. It is an upgrade of the existing cabin interiors, which can bring about notable economic and social effects.

Graphene antibacterial interior is a new multifunctional material developed on the basis of meeting the existing standards and specifications of aircraft cabin interiors. Especially during the current repeated waves of pandemic at home and abroad, this practice is of great significance to improve the antibacterial and antiviral competence of civil aviation, reinforce the long-term safety and reliability of air travel, and realize sustainable development.

Beijing Institute of Graphene Technology and COMAC Beijing Civil Aircraft Technology Research Center jointly established the "Civil Aircraft Graphene Innovation and Application Joint Laboratory", which combines the research of graphene-based antimicrobial materials with engineering applications to achieve complementary advantages. It makes the upstream and downstream industry chain of aviation interiors smooth, from project demonstration, material development and verification of the graphene antibacterial aircraft interiors to sample development, joint assessment and verification, standards and specifications formulation, advancing the industrialization of this product in China's civil aviation industry.

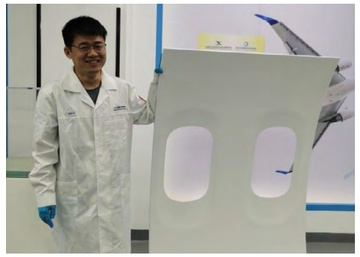


Figure .3 The Sidewall Panel

Figure .4 The Aircraft's Interiors

Enlightenment

This project originated from the graphene research of Beijing Institute of Graphene Technology. From material development, Beijing Institute of Graphene Technology has carried out a large amount of fundamental research in the antibacterial properties of polyethylene, polypropylene, polycarbonate, acrylic ester and other materials. It has developed various forms of new antibacterial products including the films, plastic, fabric and others, and achieved industrialization.

On this basis, with regard to the development needs for antibacterial aircraft interiors against the backdrop of the COVID-19 pandemic, Beijing Institute of Graphene Technology collaborated with COMAC Beijing Civil Aircraft Technology Research Center. With the advantage of COMAC in China's civil aviation industry, they have conducted targeted research and vastly boosted the industrialization of the project. Meanwhile, the project effectively lowers the infectious risks caused by bacteria and viruses to humans, reduces the number of cases, and thus plays a positive role in realizing health and well-being for humanity.

The In-situ Thermal Desorption Remediation Project of Organic Contaminated Site After Relocation of an Industrial Enterprise in Suzhou

BGE 高能环境 泰淼环境 TRS China, Co.

Beijing GeoEnviron Technology & Engineering, Inc.

3 GOOD HEALTH AND WELL-BEING

Background

The industrial enterprise in this project is located in the city of Suzhou, China, covering an area of 460,000 m². The Suzhou Land Reserve Center reserved the land after the relocation of the enterprise in 2007. The Suzhou Institute of Environmental Science was entrusted by the Suzhou Land Reserve Center to carry out a preliminary and a detailed site investigation in 2012 and 2014 respectively and developed a pilot test in 2013. The remediation project was put out to open tender in April 2016 and Beijing GeoEnviron Technology & Engineering, Inc. (BGE) was determined as the general contractor for the project.

As the general contractor, BGE was responsible for the whole process design, operation, and management. TRS China Co., Ltd, as the research and development enterprise of the in-situ thermal desorption technology, participated in the development of technical equipment and engineering application of key aspects of the project. The Suzhou Land Reserve Center was in charge of the organization, management, supervision, coordination, and the third-party acceptance inspection of the construction. In July 2018, the Beijing Municipal Research Institute of Environmental Protection and the Chinese Research Academy of Environmental Sciences, uniting as the acceptance inspection party, evaluated the remediation effectiveness of the project and concluded that the contaminated soil and underground water remediation met requirements in general and this land could be reused and exploited as residential land.

Innovative Practices

(1)The remediation region was separated as Zone A and Zone B:

The main contamination factors of soil in Zone A are benzene and chlorobenzene. Zone A has a remediation area of 17,000 m² and a total volume of 279,000 m³. The remediation here was carried out by the in-situ electrical resistance heating (ERH). ERH is a kind of technology in which electrodes are laid at specified depths through heating wells, using land as the natural conductor and utilizing an automated, graded, and variable Power Control Unit (PCU) to control the target transmission of current between the electrodes to heat soil and groundwater at different depths to the target temperature. The contaminated gas-water mixture is pumped out of the ground through a multi-phase extraction system and transported to the off-gas and wastewater treatment system for centralized disposal, thus removing the target contaminants.

The main contamination factor of soil in Zone B is petroleum hydrocarbon. The remediation area is 1,760 m² and has a depth of 3.3 meters, totaling 7,600 m³. This soil was remediated by ex-situ thermal conductive heating (TCH). TCH is the technology that indirectly heats soil to above the target temperature through an electrically driven heater to make contaminants evaporate into steam. The steam will be collected by extraction system and enter into off-gas and wastewater treatment system, thus removing the target contaminants.

Most of the waterproof curtains were made of double-row triaxial mixing piles, and some were made of triple-row triaxial mixing piles.

After the completion of the remediation, the soil in 3.5-to-18-meter deep at Zone A was checked before acceptance in-situ, while 0-to-3.5-meter deep soil at Zone A was sampled ex-situ. After passing the acceptance, this ex-situ sampled soil would be backfilled on site. All soil at Zone B was ex-situ checked before acceptance and the accepted soil would backfill the original site.

Figure .1 Off-gas Treatment System

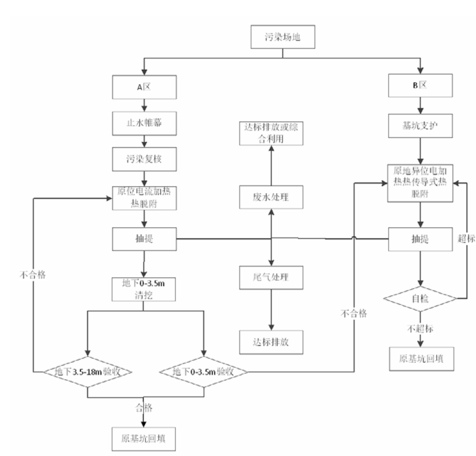


Figure .2 Remediation Technology Flowchart

(2)Breakthroughs in Key Procedures

In this project, we innovatively applied some breakthrough technologies like the fixed-depth heating and intelligent temperature control, significantly improving the equipment efficiency, while reducing the energy consumption, and making up for the deficiency existing in similar cases:

Figure .3 Power Control Unit

Improvement of the power control unit. In this project, we adopted industrial frequency alternating current as an energy source and used three independent single-phase transformers to automatically control the output voltage. The electrodes structure was upgraded into a layered one, combining with the PCU to control the target transmission of current between the electrodes, which helped to realize accurate heating of soil and groundwater at different depths. Also, we developed a central control system to automatically control the remediation system according to operation data monitored from the on-time monitoring system.

Figure .4 On-site Well Construction

We Optimized the structure of heating, extraction, and moisturizing well, realizing the three-in-one well. Electrical heating was adopted to eliminate temperature differences and to significantly improve the uniformity of formation heating. Degradation of chlorinated solvent helped to increase chloride concentration, which led to an increase of electrical conductivity of that part. It gave priority to heating the chlorine-containing area and generated "hot spots", breaking through the technical bottleneck that chlorine-containing organics are difficult to be removed in situ.

The project is over 30% more efficient than similar projects in the use of single power supply equipment, saving energy consumption by more than 40%. Besides, heating systems, in this case, require no groundwater pumping out and the heating temperature could be monitored and controlled, which means that the project

causes little damage to the soil structure and has control over the secondary pollution. Further, it makes no influence on surrounding sensitive points and meets requirements of the green and sustainable development of environmental remediation and on-site in-situ treatment policy.

Achievements

The in-situ electrical resistance heating technology applied in this project is to use electric current to conduct electricity in the ground at different depths to warm up the soil and groundwater to the contaminant desorption temperature. At the same time, the PCU is used to combine the site' s hydrogeological conditions, contaminants characteristics, and remediation progress to adjust the temperature and fine-tune the power output at any time. After more than 300 days of heating treatment, the entire site was heated to the target temperature of 100° C. During operation, the input of the off-gas treatment system VOCs is between 100-2000 ppm, and the output meets the relevant index requirements of the Ambient Air Quality Standards (GB3095-2012) and the Comprehensive Emission Standards for Air Pollutants (GB16297-1996).

After wastewater treatment, the COD detection is less than 150mg/L, which is much less than the requirement of 500mg/L for urban sewage intake pipes. All remediated soil in this project reaches the risk control value of excessive pollutants in residential land soil and groundwater. It also meets the sensory indicators of normal soil color and no odor and the requirements of urban land development and reuse, making a great contribution to the sustainable use of land in Suzhou.

Meanwhile, through the synergy of the surface sealing system and the extraction system, the influence of the surrounding groundwater and surface rainwater on the heating area is controlled, effectively reducing the heat escape to the environment, saving energy, and making a great contribution to carbon emission reduction for the sustainable remediation of polluted sites in Suzhou.

Figure .5 Project Renderings

Enlightenment

The in-situ electrical resistance heating technology applied in this project is mainly used for in-situ remediation treatment of organic contaminated sites after the relocation of urban industrial enterprises, which can effectively remove TPH, BTEX, PAHs, and other contaminants from soil and groundwater. The target customers include government, large chemical smelting enterprises, and the petroleum industry. Compared with similar technologies, it has the following advantages:

(1)Wide Range of Applications

It can target the majority of VOC/VOVs;

(2)Automatic Control

The system can automatically adjust the heating voltage by PCU;

(3)Real-time Monitoring Feedback

By equipping with intelligent control and an online monitoring system, the heating temperature is controlled in real-time to ensure the stable operation of the system;

(4)Mature Technology

It has plenty of domestic and overseas cases, and be considered as mature developed;

(5)Sustainable

It applies clean energy, controls secondary pollution, achieves complete removal of contaminants. Remediated land could be reused with effective relief of urban land pressure.

The project applies advanced technology, achieves good remediation effect, and realizes land reuse, which has very wide applicability and promotion prospects in urban polluted sites and in-production enterprise remediation projects.

· Intel: Helping Cultivate Artificial Intelligence Talents through Technology

Intel: Helping Cultivate Artificial Intelligence Talents through Technology

Intel (China) Co., Ltd.

Background

At present, Artificial Intelligence (AI) has become the new technology which is leading the way to the future. Its future is bright in terms of technological innovation, application prospects and market scale. Adequate high-quality talent is the basis for the in-depth development of AI. However, according to the current situation, the number and quality of talents in the field of AI are unable to meet the huge demand for technology and industrial development in the world. How to further cultivate the AI literacy, cognition and technical level of the whole society, especially innovative and entrepreneurial developers, and how to guide the key technologies and industrial scale to meet the requirements of sustainable development are of great importance to promote high-quality and healthy economic development. Intel has been exploring ways by means of building "ecosystems", from the creation of the environment, to technical support, to industry-university-research cooperation, to help the cultivation of AI professionals and innovative teams, and to boost the incubation and operation of AI-related products and projects.

4 QUALITY EDUCATION

Innovative Practices

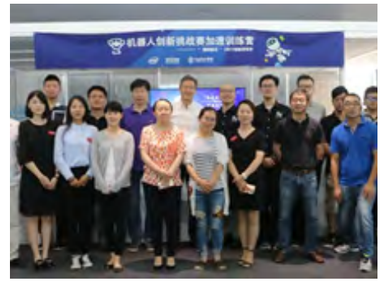
(1)Building a Robotics Innovation Center to Provide Exhibition, Communication and Incubation Services

In 2016, Intel established China's first national Robotics Innovation Center in Shanghai, which is the first industrial innovation center built and provided by Intel for the "Robotics Innovation Ecosystem". The center provides support for robotics teams to settle in, supports the innovation and entrepreneurship teams to exhibit and release innovative products, regularly holds cutting-edge technology sharing activities, along with roadshows and competitions, and provides accelerated services (including incubation exchange and investment direction guidance) for various innovation activities of its partners.

In addition, an "Innovation Ecosystem Summit" has been held every year since the establishment of the Innovation Ecosystem, bringing together extensive industry-university-research resources in the field of robotics in China, promoting exchanges and cooperation in the industry, and connecting industry resources for innovators and entrepreneurs. The "Robotics Innovation Ecosystem" will also present awards to outstanding partners, to set a benchmark for enterprises, honor industry models, endorse partners and help accelerate their growth.

(2)Holding the Robotics Innovation Challenge to Accelerate the Growth of Innovation and Entrepreneurship Teams

Intel empowers young people through diversified competitions to stimulate their interest in AI and develop their ability to cope with social, environmental and other sustainability challenges. The Robotics Innovation Challenge was held for three consecutive years from 2017 to 2019. Thousands of robot start-up teams were selected and boosted through competitions and training camps. Intel provided support, such as technology empowerment, market acceleration, the docking of investment and financing, to



promote the rapid growth of teams, accelerating the growth of innovation teams and the launching of products. In 2019, the first Intel Cup "China Graduate AI Innovation Competition" was launched for the purpose of improving the innovative and practical ability of graduates and cultivating innovative, compound and applied high-end talents.

(3)Training Educational Talents through Cooperation to Promote AI and Robotics

Intel continues to explore and develop teacher training content and resources that meet the challenges from new technologies, like AI, to help teachers actively and effectively carry out education and teaching through such tools as AI teaching assistant and emotional learning, and to help them adapt to the changes of new technologies such as informationization and AI so as to improve their education and teaching ability.

On October 27th 2018, for the purpose of supporting the cultivation of AI and robotics talents in Beijing, Tianjin, Shanghai and Chongqing (China), the Intel Robotics Innovation Center, through the cooperation with the Education Commissions of the four municipalities directly under the Central Government, provided AI training for teachers in 12 middle schools. A ROS-based artificial intelligence robot teaching platform was designed to enable teachers to quickly learn and master the knowledge system of AI. The platform, which is highly interactive and interesting, combines programming learning with AI and robotics, making it possible to develop an interactive voice recognition function for voice dialogue, and a visual interaction function, through which the robots can be programmed to track people, balls or animals. After the training, the Intel Robotics Innovation Center and its partners provided the AI teaching platform to the 12 middle schools, enabling teachers to return to school and use this teaching platform to educate students and help them develop a better understanding of AI and robotics.

(4)Establishing a Cutting-edge Robotics Technology and Industry-university-research Cooperation Platform to Promote the Cooperation and Docking amongst Industry, Universities and Research

Intel works with partners to explore the integration of industries, universities and research communities in depth, so as to gather cutting-edge technical, academic and industrial forces, to gain insight into the cutting-edge trends of science and technology, to promote the integration of industries, universities and research communities, to promote the combination of research and practice, and to establish a fast lane for the cooperation between industry and academia. In August, 2019, the robot cutting-edge technology and industry-university-research cooperation platform was formally established, bringing together more than 80 Intel technical experts, business leaders, field experts, scholars and Eco partners to discuss and cooperate on a range of topics, including the robot 4.0 system and architecture, academic cutting-edge technology, Intel's existing products and solutions, technical solutions and application requirements, industrial policies and capital trends.

(5)Creating an Online and Offline Eco-technology Promotion Platform to Meet the Challenges of the Pandemic

In 2020, the global pandemic had a great impact on social economy, industry and life. The rising demands for safety, prevention and control, intelligent detection and non-contact services have a far-reaching effect on technology, products and market orientation of the entire robotics industry. With the new topics of the robotics industry, the Intel Robotics Innovation Ecosystem has created an online and offline eco-technology promotion platform, "Intel Intelligent Robot Industry-University-Research Ecological Cooperation Seminar", which further integrates various internal resources of Intel and gives full play to the enthusiasm and value of partners to upgrade the scale, content and resources of activities. Through 16 online seminars held this year, it will continue to help the robotics industry accelerate innovation and create value. Up to now, the "Intel Intelligent Robot Industry-University-Research Ecological Cooperation Seminar" has broken through the limitation of physical space, providing over 7,000 robotics industry practitioners with opportunities for academic exchange, technical training and resource docking.

(6)Leading the Robotics Industry and Serving Social Sustainable Development through Cutting-edge Technologies

Intel Labs China (ILC) has created a heterogeneous extensible calculation and development platform with low power consumption and high performance for intelligent robots (including service robots, medical robots and self-driving cars, etc.), the HERO platform (Heterogeneous Extensible Robot Open Platform) which matches with FPGA, iGPU and other special accelerator chips (such as VPU of MovidiusTM) with CPU as the control center to provide a high-performance end-to-end solution for intelligent robots.

As the best choice for robot computing research platforms, the HERO platform can greatly shorten the development time of users and can quickly realize the deployment practice of AI algorithms. By calling Intel's Computer Vision Inference and Network Optimization Development Kit (Intel® OpenVINOTM) on HERO platform, users can conveniently and efficiently complete the rapid deployment of deep learning networks on different hardware accelerators, achieving the optimization of system performance.

Centering on the HERO platform, ILC also launched a brand-new partner program and joined hands with platform-level, application-level and eco-level partners in the industry to jointly build a complete, efficient and open platform, continuously expand application scenarios and accelerate the launch of technologies and products through R&D cooperation, academic innovation and industry demonstration.

Achievements

Up to this point, the Robotics Innovation Ecosystem has attracted more than 350 partners and about 20,000 developers online. It has boosted more than 1,000 teams from the perspectives of technology, talents and business services. Over 100 innovation and entrepreneurship activities and technical trainings have been held, and nearly 100 experts participated in the activities. The system has launched 10 key AI technology platforms and created 10 successful cases.

In China’ s service robot industry, a growth of 44% was achieved last year, reaching a market value of 1.8 billion US dollars, while industrial robots have become the largest market in the world for six consecutive years, accounting for 36% of the total global robot installations. Regarding the development of the robotics industry, robots have expanded from the initial industrial application to many service fields such as patrol inspection, cleaning and education, and addressed social problems like labor shortage. Since the outbreak of COVID-19, contactless services such as unmanned disinfection and sterilization, teleconferencing and online teaching have been indispensable measures, and the robotics industry has entered a new stage of solving practical problems for our society.

Enlightenment

Technological innovation is the core driving force of human development. Scientific and technological talents and a favorable environment can help innovators and entrepreneurs achieve their ideals and goals, which needs the attention and support from our society. For emerging strategic industries such as robots and AI, which are related to the future development and destiny of mankind, sustained and sound development of these industries shall be achieved by gathering global innovation resources, mobilizing partners to actively participate and creating an open and cooperative environment and atmosphere. The United Nations 2030 Sustainable Development Goal 4 “Quality Education” includes “increasing the number of youths and adults who have relevant skills for gainful employment and entrepreneurship”. As the world’ s leading technology company, Intel focuses on strategic emerging industries such as AI and robotics, unites innovative partners, actively explores effective ways to improve the quality of human resources required by industry, in order to promote the development of AI and robotics industry in China by means of open cooperation in terms of technological breakthroughs and accelerated market expansion.

· Beijing Economic and Technological Development Zone Reclaimed Water Plant

Beijing Economic and Technological Development Zone Reclaimed Water Plant

北京亦庄水务有限公司
BeiJing Yizhuang Water Co.,Ltd

Beijing Yizhuang Environmental Technology Group

6 CLEAN WATER AND SANITATION

Background

(1) Beijing is one of the big cities with serious water shortage in the world. The shortage of water resources has become the main factor affecting and restricting the social and economic development of Beijing.

(2) Beijing Economic and Technological Development Zone is an important base for Beijing to develop high-tech industries. According to the long-term plan, it will be built into a modern satellite city. In recent years, with the rapid economic and social development of the Development Zone, the production water consumption will continue to grow. At the same time, with the strengthening of the ecological and environmental construction of the Development Zone, the water consumption for greening and landscape will also be greatly increased. All these significant increases in water consumption will be seriously restricted by the lack of water resources in Beijing.

(3) Beijing Economic and Technological Development Zone is a "national industrial water saving demonstration park". According to the characteristics of the Development Zone, the construction of high-quality reclaimed water project is not only the urgent need to adapt to the situation of water shortage in Beijing, but also the requirement to build "national industrial water-saving demonstration park", ecological water-saving satellite city and water-saving society, and the inevitable requirement to adhere to sustainable development and coordinate the harmonious development of human and nature.

Innovative Practices

In this project, a reclaimed water plant with a daily output of 20000 tons of high-quality reclaimed water and related pipe network supporting projects were constructed. After the treated sewage of Jinyuan sewage treatment plant reaches the standard through double membrane treatment, the high-quality reclaimed water is transported to the enterprises in the area through the reclaimed water supporting pipe network as production water. It can not only ease the difficulty of water use in the Development Zone, but also protect the ecological environment of the development zone and its surrounding areas.

This project includes the reclaimed water plant project and the reclaimed water supporting pipe network project. The reclaimed water plant project includes double membrane treatment facilities and its supporting projects. The reclaimed water supporting pipe network project includes the laying of reclaimed water transmission pipeline and the establishment of a water monitoring and management system, etc.

The reclaimed water plant takes the secondary effluent from the sewage treatment plant in the development zone as the water source. The main project contains the reclaimed water treatment system (including pretreatment unit, micro-filtration unit, intermediate water tank, reverse osmosis unit, dosing room and clean water tank) and other supporting facilities. The double membrane process "micro-filtration + reverse osmosis", namely "MF + RO" combined desalination process, is adopted to make the effluent quality reach the design water quality standard of high-quality reclaimed water after advanced treatment. The effluent of the wastewater treatment plant enters the pretreatment system of the reclaimed water plant to remove large particle impurities, hair and more than 200μm suspended matter. After being pressurized by the lift pump, the suspended solids, bacteria, some viruses and large-size colloids are further intercepted to ensure that the water quality meets the requirements of reverse d. The micro-filtration effluent is temporarily stored in the intermediate water tank as the influent of reverse osmosis, while balancing the water quantity difference between micro-filtration and reverse osmosis. The micro-filtration produced water in the middle water tank is supplied to the reverse osmosis treatment unit through the reverse osmosis water supply pump. Desalination is carried out in the reverse osmosis treatment unit. The produced water is stored in the clean water tank after disinfection and pH adjustment. In 2018 reclaimed water plant in the Development Zone was carried out intelligent upgrading, including an intelligent water preparation plant, an integrated platform of digital reclaimed water plant, and realized the intelligent production of high-quality reclaimed water preparation.

The project provides high-quality production water for industrial enterprises in the development zone through the reclaimed water supporting pipe network, and can also be used as municipal miscellaneous water sources for urban greening, toilet flushing in residential areas, landscape water and so on.

Figure .2 Micro-filtration

Figure .1 The Reverse Osmosis Equipment of the Sewage Treatment Plant

Achievements

As of June 2021, the project has produced 44.6 million tons of high-quality reclaimed water. The main water users are LCD panel, communication integrated circuit board and other high-end manufacturing industries, which effectively alleviates the shortage of water resources in Beijing Economic and Technological Development Zone. Reclaimed water has become the second water source in the zone. The project is an important demonstration of engineering to promote sustainability by improving sanitation facilities and provide sustainable clean water through engineering innovation. The upgrading of this project was selected into the Beijing-Tianjin-Hebei Water Saving Action Plan jointly issued by four official ministries and commissions including the Ministry of Industry and Information Technology in 2018.

Figure .3 Overlook of Beijing Economic Development Zone Reclaimed Water Plant

Enlightenment

This reclaimed water plant is the first water plant in the development zone, which was built for the purpose of industrial reuse and the utilization of sewage resources. It is an effective way to alleviate the problem of water shortage and water environmental pollution, and is also an important measure to achieve the goal of "carbon peak and carbon neutral". The construction of high-quality reclaimed water projects is not only an urgent need to adapt to the situation of water shortage in Beijing, but also a requirement to build a "national industrial water-saving demonstration park", an ecological water-saving satellite city and a water-saving society. It is also an inevitable requirement to adhere to sustainable development and coordinate the harmonious development of human and nature. The successful application in the development zone provides an important way to alleviate the problem of water resources shortage and promote industrial development of our national industrial parks.

8 DECENT WORK AND ECONOMIC GROWTH

- Digital Twins and BIM Technology Based Construction of Steel & Iron Base
- Forever Technology Vocational Skills Training Program in Rwanda

Digital Twins and BIM Technology Based Construction of Steel & Iron Base

MCC Capital Engineering & Research Incorporation Ltd.

Background

With the gradual development of the Chinese government's environmental governance and the adjustment of national industrial policies, the demand for iron and steel products has shifted from scale expansion to quality improvement. The era of large-scale capital construction of enterprises has passed. Optimization of process methods, improvement of equipment technology and product quality, reducing cost and emission, saving energy etc., have become the focus of enterprises' attention. Especially the iron and steel enterprises around Beijing, Tianjin and Hebei cities also need to bear the social responsibility. On one side, they need to reduce the impact of existing enterprises on the environment by adopting new environmental governance processes, equipment and methods; on the other side, they need to improve the comprehensive technical capacity of iron and steel enterprises by overall relocation and transformation and building city-friendly enterprises, while building better, low-carbon and environmental-friendly iron and steel enterprises.

Hebei LeTing iron and steel complex is a super large coastal iron and steel complex established by replacing the production capacity of XuanHua Iron and steel enterprise in Hebei Province, which uses the latest digital twin technology of three-dimensional digital design, construction, operation and maintenance. The project covers an area of 534 hectares, with an investment scale of 6 billion dollars, involving the whole process of raw material yard, coking, blast furnace, steelmaking, continuous casting, rolling, power supply and other steel processes, realizing the landing of new technologies such as intelligent three-dimensional model, unified data coding, parametric modeling, intelligent operation and maintenance.

8 DECENT WORK AND ECONOMIC GROWTH

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Innovative Practices

At present, the Chinese domestic large-scale iron and steel enterprises have basically completed the construction of the main information system from PCS, MES to ERP, and have basically realized the automatic production in the independent process section. However, due to the complexity of its equipment, the dynamic and unpredictable process of iron and steel production, there is still no digital and intelligent plant. In the construction of Hebei LeTing iron and steel complex, combined with more than 70 years of experience in plant design and engineering general contracting of iron and steel industry, with 3D digitization as the center and from the starting point of digital design, MCC CERI researched the application scenarios of digital delivery, operation and maintenance of iron and steel industry, established a complete set of multi professional and 3D digital joint design platform. The unified digital coding platform and the whole process display platform realize the digital delivery, operation and maintenance of the whole life cycle of the super large iron and steel enterprises.

The traditional iron and steel enterprises lack a continuous overall planning and management platform. There are even conflicts, contradictions and repeated construction in project planning and product upgrading planning in different stages. The lack of a blueprint for the whole life cycle of the plant has brought great losses to the enterprise and society. From the early stage of planning and construction of Hebei LeTing iron and steel complex, MCC CERI has established a full professional joint design platform with cloud platform and 5G technology, which has realized the simultaneous online design and programming of multi-professional engineers from different countries and regions, broke through the data barrier between different professional design software, realized the information sharing of cross-professional data and process. It lays a good foundation for the complete enterprise digital delivery.

The traditional iron and steel enterprises lack an effective overall digital platform, in which design data, production data, operation and maintenance data and other related basic data

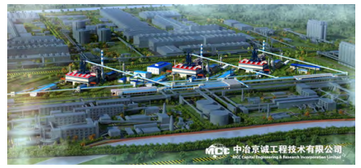


Figure .1 Hebei LeTing Iron and Steel Complex Project – the Blast FurnaceFigure .1 Hebei LeTing Iron and Steel Complex Project – the Blast Furnace

Figure .2 Hebei LeTing Iron and Steel Complex Project – the Factory

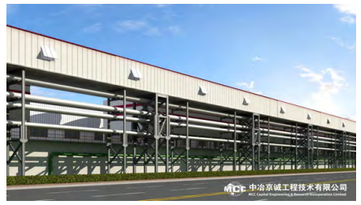


Figure .3 Hebei LeTing Iron and Steel Complex Project – the Circulating Pumping Station Pipeline

are not connected with each other, and information islands, data barriers, repeated construction and other phenomena occur many times. The project adopts the unified coding rules accumulated by MCC CERI for more than 70 years, establishes a complete set of perfect asset management system, involving engineering design, construction, construction, operation and maintenance, spare parts management and other aspects, realizes more accurate material procurement, information tracking and other digital information linkage. And it enables the material flow, energy flow and information flow in the super large iron and steel enterprises to be highly unified and integrated.

The project has successfully set a model of digital intelligent plant for iron and steel enterprises, and greatly improved the management and scheduling as well as operation and maintenance management of the enterprise. During the implementation of the project, MCC CERI actively promote the establishment of relevant Chinese national standards, which will greatly enhance the international influence of Chinese iron and steel enterprises.

Achievements

This project centers on the digital cloud service of MCC CERI company, comprehensively integrates 3D digital design, operation and maintenance, creates products from a digital plant based on forward design, and provides comprehensive digital cloud service to domestic iron and steel enterprises.

The project develops, explores and cultivates the digital design, construction, delivery and operation and maintenance platform products for the construction of iron and steel enterprises, and helps the digitalization of the overall business of the iron and steel industry. By the construction of the digital delivery platform, information of each stage of EPC in iron and steel industry is collected and enriched efficiently, and becomes a network data asset with “object” as the core, so as to realize the digital delivery of the whole life-cycle information of engineering construction. Through the construction of digital operation and maintenance platform, a digital operation and maintenance system integrating MES, ERP and other stock data assets of the factory based on digital delivery data assets of the project is constructed to provide customers with a new 3D visual operation and maintenance management mode and build a solid foundation for intelligent plant.

The project has improved the digitization and informatization of iron and steel enterprises to an advance level in the world. The accuracy of digital model has reached 100%, and a complete enterprise digital asset has been established. The initial investment of the project has been reduced by 0.9%, the efficiency of virtualization skills training has been increased by 60%, and the investment in spare parts has been reduced by about 40%.

Enlightenment

Based on the construction of large-scale coastal iron and steel complex, combined with more than 70 years of plant design and EPC experience in the iron and steel industry of MCC CERI, research and development of digital delivery and operation and maintenance platform for iron and steel enterprises has been carried out, aiming to establish the overall planning blueprint of the enterprise in a digital way, and integrate the design data in the early stage of the project and the operation and maintenance management data after commissioning. It facilitates the information flow transmission of the whole factory, and helps enterprises realize the whole life cycle management of digital delivery and digital operation and maintenance. At the same time, the digital delivery and operation and maintenance platform provides services to more joint design units and factories through cloud technology, and comprehensively supports the business of upstream and downstream units from the design institute to the steel plant.

The project establishes the foundation for intelligent manufacturing, digital design, construction, delivery, operation and maintenance and enterprise data assets, and creates a real digital twin factory, which provides a good engineering practice case for China and even the world to gradually realize enterprise intelligent manufacturing and sustainable development.

Forever Technology Vocational Skills Training Program in Rwanda

恒华科技
FOREVER TECHNOLOGY

Beijing Forever Technology Co., Ltd

8 DECENT WORK AND ECONOMIC GROWTH

4 QUALITY EDUCATION

17 PARTNERSHIPS FOR THE GOALS

Background

The Rwandan market is in urgent need of power and construction machinery operators. Rwanda has incorporated narrowing the skills gap and knowledge-driven economic development into its 2020 vision plan in order to solve multiple problems including the general lack of skilled labor force in the sector. According to the 2016 Rwanda Workforce Skill Gap Survey, Rwandan major skill gaps are in the sector of energy and infrastructure.

The cooperation between China and African countries in 2018 entered a new stage. In July, President XI JINPING opened up a new term for the Middle East and African diplomatic tour, and signed cooperation documents named as "One Belt and One Road". In addition to basic education, the Chinese government and enterprises also vigorously put effort to vocational skills education and training.

Forever won the bid for the smart grid informatization project in Rwanda funded by the World Bank in 2016. Based on its advantages and market opportunities, Forever has formulated a two-wheel drive strategy of "driving market expansion by education and promoting technology output by education". In this context, Forever has achieved strategic intention to collaborate on this project with the Rwandan Workforce Development Authority (WDA). The company will provide expertise teaching materials and trainers in relevant areas.

Innovative Practices

(1)The Investment and Settlement of Forever TVET Institute in Rwanda

In February 2018, Forever Technology signed a strategic cooperation agreement on vocational skills training with WDA Rwanda, and invested and registered Forever TVET Institute focusing on education and training in Rwanda. In a short period of five months, Forever Technology has not only installed a number of the most advanced teaching equipment on the local campus, but also selected more than a dozen Rwandan trainers majoring in mechanical or engineering construction to go to China for heavy machinery training. Excellent candidates were hired as heavy machinery teachers of Forever TVET Institute. The first phase of construction machinery operator training was carried out locally in Rwanda with fruitful results.

(2)The Establishment of a Curriculum System to Meet Local Needs

Forever TVET Institute obtained the accreditation issued by WDA in July 2018, which laid a solid foundation for the follow-up development of "Internet +" vocational education and training. At the same time, the first phase of heavy machine operation major students officially opened the class. The teaching mode of heavy machine operation specialty is divided into three stages: Theory, Simulation and Practical Training. The theoretical teaching based on mechanical principle provides students with knowledge reserve, the simulation teaching with the combination of 3D scene and VR provides students with immersive experience operation, and the practical teaching of physical machine operation enables students to meet the employment requirements of skillfully operating movements with different job requirements. Students are provided with no less than 60 hours of theoretical courses, 100 hours of simulation courses and 100 hours of practical training courses.

Forever established a cooperative relationship with the Rwandan Police Department to conduct the Category F driving license test, and provided different machinery and equipment options for the local citizens to obtain the Category F heavy machine operation driving license. A proposal was filed to the police to classify and distinguish the F-class heavy machine operation driver's license, and to specify the types of equipment, including but not limited to excavators, loaders, rollers, forklifts, etc.

(3)The Development of Customized Service for Trainees

Forever TVET Institute actively cooperates with local infrastructure companies and related companies, makes full use of social resources, looks for employment in many ways, and gives priority and individual recommendations according to the actual situation of graduates. At the same time, it also actively carries out market research and development, and collects information on potential or under construction projects of local cooperative enterprises and Chinese enterprises in Rwanda so as to provide reliable jobs for graduates.

Achievements

Forever TVET institute is the first TVET school established by local Chinese enterprises. Through the cooperation with education sector, the backward semi-apprenticeship model at the construction site has been transformed into a standardized theory simulation training and other teaching modes, and the curriculum of heavy machinery operation has been standardized, to promote the development of skills and education in heavy machinery, electricity, surveying and mapping, transportation and other areas in Rwanda.

A large number of information technology means are used in the training courses. Referring to China's mature experience, we continue to introduce the "Internet+" education model to Rwanda, by means of exploring MOOC, SPOC, VR, VI, learning points, credit exchange, certification exchange, resource sharing, credit bank and other local education operation methods.

The project provides an effective platform for local citizens to learn modern professional technology. Based on market demand, we have trained more high-skilled talents with good technical level for the Rwandan labor market, forming a virtuous model driven by the cycle of the engineering and education industries.

The circular training mode of going deep into the post promotes the sustainable development of vocational education. For the purpose of sustainable development, teachers of all kinds of specialties such as heavy machinery, electric power, surveying and mapping, transportation and so on are dispatched to the practical posts of cooperative enterprises to participate in engineering practice, or experts from enterprises and industries are invited to our school to carry out on-the-job promotion training for teachers, which improves the agreement between teaching and working practice.

Enlightenment

UN 2030 Sustainable Development Goal 8 is to "promote inclusive and sustainable economic growth, employment and decent work for all". The implementation of Forever's vocational skills training program in Rwanda is a typical case of the engineering field providing assistance and support to developing countries and underdeveloped countries to improve local productive employment. During the implementation of this project, there have been many breakthroughs: teaching people how to fish, helping countries along the route to improve the quality of labor force; employment recommendation, establishing a bridge between local people and engineering enterprises; the application of "Internet+", realizing an exploration of Chinese private enterprises' vocational education going abroad.

Through the implementation of the Forever Technology vocational skills training project in Rwanda, the skills level of the young labor force in Rwanda has been improved, the skills gap has been narrowed, and the country's talent gap in the field of energy (especially power generation, transmission and distribution) and infrastructure (especially the operation and maintenance of construction machinery and equipment) has been made up. Meanwhile, Rwanda has become the center gradually radiating to its neighboring countries, by deepening the "Internet+" model, building a platform for smart education and a "knowledge economy" ecosystem to promote the implementation of Rwandan strategic plan and the "Belt and Road Initiative", and to contribute to the 2030 UN Sustainable Development Goals.

· North Canal Gantang Lock Project

· AI Construction Project of Dayun AI Town

· Phase II Reconstruction and Extension of of Changsha Xinkaipu Wastewater Treatment Plant

North Canal Gantang Lock Project

金河水务
GOLDEN RIVER WATER

Beijing Golden River Water Resources & Hydropower Construction Group Co,. Ltd.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Background

The navigation of the North Canal Tongzhou section is one of the measures taken by the sub-center of Beijing to build a fresh and bright eco-city with river and city harmoniously sitting together. It is also an important embodiment of the protection, inheritance and utilization of the cultural belt of the Grand Canal in Beijing. The project will undertake the main task of opening up the waterborne transportation passage through the Tongzhou channel segment. It is also one of the key projects of the overall restoration of the North Canal Tongzhou section. Through this project, ships will overcome the water level difference between upstream and downstream, and the course between Beiguan and Yangwa sluices will be connected, realizing the whole-route navigation of the North Canal through Beijing. Also, it lies the foundation for the restoration of the Grand Canal through Beijing-Tianjin-Hebei urban agglomeration.

The North Canal Gantang Lock Project is a double-track lock one. The channel length is 1.2km, the effective length and width of the lock chamber is 65m and 10m respectively, and the threshold water depth is 2.5m. The project set three construction areas. 1st area: upstream channel construction area, a total length of 610m; 2nd area: the main construction area (upper lock head, lock chamber and lower lock head), with a total length of 104m; 3rd area: downstream channel construction area, total length of 486m. This project is characterized with long management line, high requirements for safe and civilized construction, and a considerable number of embedded parts, etc. Therefore, in order to make the blueprints easier to understand, BIM technology is applied through 3D technical disclosure. The application of aerial photography technology helps quickly obtain terrain data. And the use of information system enhances management ability and effects, improves management efficiency, further promotes the development of digital management of the enterprise.

Innovative Practices

To solve the problems encountered in the construction of this project, BIM technology was adopted as a basis of the informatization promotion in various aspects through the bidding, preparation, and implementation stages of the whole construction process. Therefore, it can enhance the engineering management ability, promote the standardization level, meanwhile, solve the inherent problems of water conservancy projects.

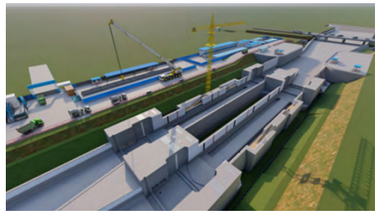


Figure .1 North Canal Gantang Lock Project- 3D Construction Site Layout

As for the construction site layout, CAD, Revit, Lumion and other software can be used to generate construction scene. The CAD drawings with elevation data are used to generate the real terrain model in Revit, and the structural and part family models are imported into the project files to simulate the layout of the construction site and find the best layout scheme.

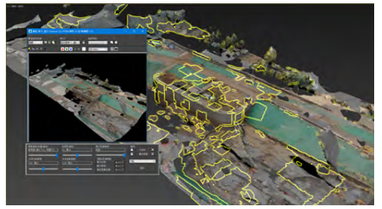


Figure .2 North Canal Gantang Lock Project- Topographic Mapping

In terms of topographic mapping, UAV aerial photography technology was used to scan and map the terrain, 3C software processing to quickly obtain more accurate terrain data with accurate elevation, adequate mapping points and high terrain restoration.

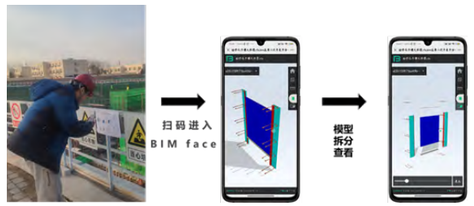


Figure .3 North Canal Gantang Lock Project- Technical Disclosure

For technical disclosure and expression, the methods of technical disclosure have been enriched. It also splits and analyzes the 3D model according to disclosure demands, so that workers can get information from GIF construction animation via QR code scanning, which makes it easier to understand the drawings.

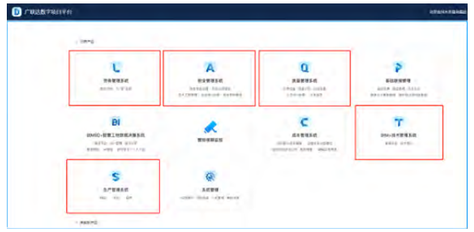


Figure .4 North Canal Gantang Lock Project- Project Management

In terms of project extensive management, this project makes full use of BIM management platform application to refine management details, implement management actions and enhance management abilities through rational use of the five modules of the platform.

As for the standardization of internal inspection, thAs for the standardization of internal inspection, the quality and safety control modules of the BIM management platform can be applied to develop and update weekly inspection plans for project quality inspectors and safety personnel, and upload them in real time through the platform in order to achieve management standardization and make the management process fully traceable.

To solve the remaining problems left by previous documents, the whole project department uploads daily work report, image data, management process materials, personnel information and meeting minutes to the management platform in time for sorting and achieving. The time-lapse photography has been used to record the construction process, providing information for the process record and project review.

Figure .5 North Canal Gantang Lock Project- Standardization of Internal Inspection

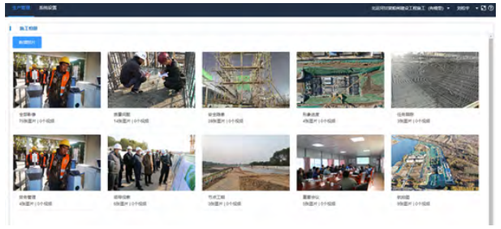


Figure .6 North Canal Gantang Lock Project- Engineering Data Archives

Achievements

(1)Construction Site Layout

During the early stage of construction, BIM engineers made a reasonable regional layout planning, people flow and traffic flow track planning map and construction responsibility zoning map taking advantages of 3D planning. The problems that detailed design and planning could not be realized are solved, since reasonable planning can be achieved by means of three-dimensional field distribution. In this project, engineers also simulated the greening design scheme, made scene rendering through visual methods, allowing the business owner to experience the real greening effect, find deficiencies of the design, and make reasonable modifications before construction.

(2)UAV Topographic Mapping

Compared with the traditional earthwork measurement method, UAV, Acute3D Viewer software and other technologies can not only improve the calculation efficiency and the calculation precision of earthwork quantity, but also get the filling and excavation distribution of the whole construction area through 3D and data analysis, which can directly guide the earthwork scheduling on the site, thus saving the labor and mechanical costs of the earthwork.

(3)Complete Technical Explanation

This project has individually displayed the methods like model positioning, overall appearance simulation, construction parts split analysis, highlighting annotation of key parts. Then with animation demonstration, 2D code and 3D model lightweight view, GIF animation demonstration and other means have been applied to clarify technical method and knowledge, so that workers can better understand the drawings and design intention.

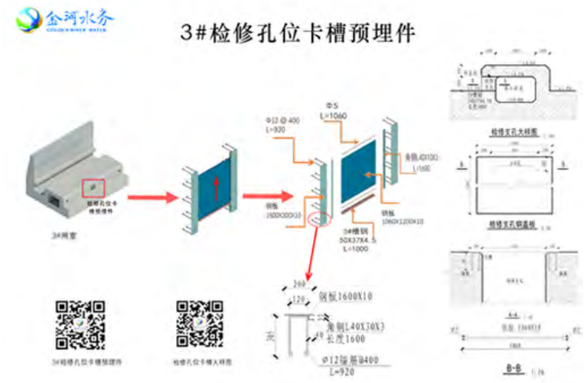


Figure .7 North Canal Gantang Lock Project- Technical Disclosure

Enlightenment

Through the application and exploration of BIM in water conservancy engineering, the BIM technical ability of the staff can be improved, leading to a better working mode, and also the management quality can be enhanced. The waste caused by unreasonable resource allocation can be reduced, and project personnel can better manage construction work at the front line.

(1)Economic Benefits

In this project, BIM technology is applied to supplement the original scheme and technical explanation is provided to save construction time. In the aspect of management, the information management platform is used to strengthen the control of the project and improve the management efficiency so as to reduce the cost of the labor management.

(2)Social Benefits

This project can help to promote the application of information technology in water conservancy engineering industry, find the application points of BIM in water conservancy engineering, summarize the standardized elements of information application, close the gap between water conservancy BIM application and housing construction project, improve the BIM application method according to the characteristics of water conservancy project, and pave the way for the implementation of water conservancy project construction information and the application of BIM regularization and standardization.

The project aims to promote the building of high-quality, reliable, sustainable, and resilient urban infrastructure, effectively support economic development as well as improve human well-being through the application of BIM engineering tools.

AI Construction Project of Dayun AI Town

大象数科

Shenzhen Elephant Data Technology Co., Ltd

Background

Dayun AI Town is located at Longgang District of Shenzhen City and is a major industrial project in the Greater Bay Area of Guangdong-Hong Kong-Macau, the leading demonstration area of Shenzhen. It is a part of the southern extension area of Dayun New City in east-central Shenzhen, bordering Shuiguan Expressway to the south and surrounded by mountains to the east and northwest. The park covers an area of about 343,400 square meters and a total construction area of about 607,600 square meters. The goal of building a new infrastructure for artificial intelligence industry in Longgang, Shenzhen, is to be implemented in two phases. The first phase, covering an area of about 360,000 square meters, was started in July this year and the park is scheduled to open in July 2021. The second phase, covering an area of about 250,000 square meters, is scheduled to start in March 2022 and open in March 2023.

The project is carried out by Longgang District Industrial Investment Service Group, a state-owned enterprise in the Big Data Center of Longgang District of Shenzhen,and Shenzhen Elephant Data Technology Co., Ltd to upgrade and transform the old industrial area in a comprehensive manner. According to the construction goal of “AI Park, AI Industry and AI Operation”, Dayun AI City will be developed into a sustainable innovation infrastructure of the whole industrial chain dominated by AI industry, which can be used as an large-scale industrial, residential and travel center.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Innovative Practices

(1)Spatial Reconstruction Based on AI Industrial Ecology

Given the problems of old building, scattered industry, low function and lagging adaptation, the park's design is "one axis, two belts, and three centers," i.e., one axis for AI experiences, one belt for AI innovation, and one green belt for science and technology. Science and technology research and development center, technology transformation center, intelligent life center, fusion of college resources around the project, high-level talent, high-tech enterprises, innovation platform, investment and financing platform and other resource advantages, restructuring R & D, production, life integrated in the industrial chain, innovation chain, talent chain, education chain coordinated national artificial intelligence assembly to lead the industrial space We will promote the deep integration and sustainable development of artificial intelligence industry and the real economy, and build an industrial cluster town with an output value of 10 billion and tax revenue of one billion by 5-8 years.

Figure.1 Spatial Reconstruction of "One Axis, Two Belts and Three Centers"

(2)AIOT Intelligent Database

The AIOT database of the park will be built, and all kinds of intelligent terminals including intelligent parking, intelligent energy consumption, intelligent security and facial recognition, will be established in Dayun AI Town. The data services will be provided to build open AI + 5G IoT application scenarios, and realize AI of the park; At the same time, all kinds of data and application scenarios will be collected in the park and provided to the whole AI industry to promote the research and development process of AI applications. The system has connected more than 20 kinds of intelligent edge systems and more than 3,000 intelligent terminals, providing real-time data services for people, vehicles, homes and enterprises in the park, and supporting the innovation of multi-scene applications.

Figure.2 Public Algorithm Training Platform for Artificial Intelligence Industry

(3)Public Algorithm Training Platform for Artificial Intelligence Industry

In Dayun AI Town, the public algorithm training platform of artificial intelligence industry is built to provide the three core elements of artificial intelligence industry: Computing, Data, and Algorithm, and to solve the three problems of AI enterprises: Lack of basic data support, heavy load, inability to iterate quickly to improve the algorithm. Based on the results of building the intelligent city Longgang District in Shenzhen, the project opens up four kinds of data resources and 86 algorithm models, such as business data, spatial data, panoramic image data and dynamic data from government agencies. At the same time, it fully unlocks computing power and supports low-cost sustainable innovation by AI startups.

Figure .3 Data-driven Inclusive Financial Service Platform

(4)IOC System of Intelligent Park Management Center Based on Digital Twin

① Construction of Intelligent Park Management Center

The implementation of the overall park situation, security situation, energy consumption situation, facility situation, personnel situation, vehicle situation and other 3D data visualization based on screen perception, form the industrial service brain and operation core of Dayun AI Town.

② Construction of AI Industrial Exhibition Center

By integrating AI systems through intelligent Internet-of-Things technology, the Exhibition and Experience Hall on artificial intelligence is built with the ability of intelligent digital twinning. A series of AI+ application scenes will be exhibited here: AI+ UAV, AI+ Finance, AI+ Energy, AI+ Home, AI+ Logistics, AI+ Intelligent Manufacturing, AI+ Medicine, AI+ Agriculture and Trade Exhibition. The exhibition focuses on system access, dynamic data presentation, intelligent interactive experience and mobile digital sharing as the market interface for AI enterprises in the park.

③ Carbon Neutrality Digital Intelligence Management System

The carbon neutrality management system of the park is built based on the energy consumption data of the database and the photovoltaic power generation data, and the carbon neutrality data and algorithm model of the park is established. The energy consumption can be reasonably controlled by the edge energy saving algorithm so as to reduce the energy consumption per unit of product and CO_2 emission, improve economic benefit of the enterprise, and realize sustainable development of the carbon neutrality park.

Figure .4 IOC System of Intelligent Park Management Center

Figure .5 Intelligent Park Management Center

Figure .6 AI Industrial Exhibition Center

Figure .7 Carbon Neutrality Digital Intelligent Management System

Achievements

AI industrial ecology: the Chinese University of Hong Kong (Shenzhen) and other 6 related scientific research institutes, Huahai Wisdom (Shenzhen) and other 13 artificial intelligence benchmarking enterprises, KFC and other 3 well-known enterprises have officially signed the first set of entry projects, marking the initial formation of an artificial intelligence industrial chain and ecosystem in the park.

AI industrial innovation: more than 20 kinds of intelligent products, such as smart water meter, smart electricity meter, vehicle perception, personnel perception, fire safety perception, intelligent lamp posts, information release, logistics robots, floor mopping robots, etc., have been gradually connected to the intelligent database of the park AIOT, and the AI innovation environment has entered the practical stage.

AI industrial service: this town has integrated the regional resources of colleges and universities, high-tech enterprises, innovation platform, investment and financing platform and other resource advantages, the establishment of "industrial park + innovation incubator + industrial fund + industrial alliance" integrated support model, with integrative financial services as a breakthrough, to form a data-driven new industrial service model to promote the sustainable development of AI industry.

Enlightenment

As a new infrastructure project for the artificial intelligence industry in the Bay Area, Dayun AI Town has always adhered to the concept of industrial innovation and sustainable development, promoted the exploration of industrial infrastructure digitalization and industrial service digital empowerment, and provided digital infrastructure for ecological, innovative and sustainable development. The main experience of building the AI Town in this round of construction can be summarized as follows:

First, based on the super-integrated intellectual network technology, this town has connected the relevant element resources of the AI industry, built a public algorithm training platform for the AI industry, an intelligent AIOT database and other digital infrastructure, and enabled AI enterprises to innovate sustainably.

Second, we comprehensively used cloud edge coordination, digital twins and other cutting-edge technologies to realize the construction of a park service system, provide data-driven industrial services, leverage limited investment in facilities to create an innovative and ever-changing AI industrial ecology, and realize the sustainable development of the park.

Phase II Reconstruction and Extension of of Changsha Xinkaipu Wastewater Treatment Plant

Tongji University &
Hunan Sanyou Environmental Technology Company Limited

Figure .1 The Panoramic View of the Second-phase Reconstruction and Expansion Project of Changsha Xinkaipu Wastewater Treatment Plant

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Background

The first-phase project of Xinkaipu Wastewater Treatment Plant (WWTP) has a design scale of 100,000 m^3/d. In recent years, Xinkaipu WWTP has been fully utilized or even overloaded for a long time, which could not meet the increasing demand of wastewater treatment. In addition, with the continuous improvement of environmental protection requirements, tailrace discharge standards have been further improved. Therefore, the implementation of the upgrading and capacity expansion project is imperative.

Based on the upgrading and capacity expansion project, the treatment scope of Xinkaipu WWTP is to be expanded from the current 100,000 m^3/d to 190,000 m^3/d in the second-phase, and the effluent quality is to be raised from the National Grade 1-A to meeting the Grade 1 of Hunan Province (i.e. Quasi-IV standard for surface water).

Due to the high cost of protracted demolition, the original plan is not suitable to be implemented further. Therefore, the owner proposed to design other technological schemes without land acquisition, and realize the expansion goal in the second-phase by using the potential of the existing WWTP. Based on the successful pilot and production tests, the high concentration powder carrier bio-fluidized bed (HPB) technology, jointly developed by Tongji University and Hunan Sanyou Environmental Technology Co., Ltd., was finally adopted after multiple searches and comparisons. With this technology the upgrading and capacity expansion can be used to complete under original plant without land acquisition, and continuous production and transformation can be achieved, with a total investment of about 352 million yuan. The total investment, operating cost, and construction time of the project could be significantly reduced.

Innovative Practices

In this project, the current AAO biochemical tank was transformed with HPB technology, and the capacity expansion objective can be achieved without the need for a new biochemical tank, i.e., the treatment capacity of the biochemical tank has been increased from the current situation of 100,000 m^3/d to 190,000 m^3/d. Meanwhile, the effluents COD, NH3-N and TN of the secondary settling tank can meet the Grade 1 in discharge standard of major pollutants for municipal WWTP of Hunan Province, and the total water quality can meet the Grade 1 of Hunan Province only the removal of TP and SS in the back-end advanced treatment needs to be strengthened.

(1)Transformation of the Biochemical Tank (HPB Biochemical Tank)

The transformation of the biochemical tank was completed under conditions of uninterrupted production and no decrease in production. The transformation process is relatively simple, and there is no need to change the civil construction. The basic idea is to increase the sludge concentration by adding a composite powder carrier to the biofilm and adding hydraulic stirring system. In addition to increasing the concentration of the mixed liquid in the biological tank, a microbial system of "double sludge" symbiosis with suspension growth and attachment growth is established. Meanwhile, a composite powder carrier recovery unit is set up to achieve the two independent sludge residence times, which can simultaneously improve the efficiency of biological nitrogen and phosphorus removal.

① Agitator arrangement

As the concentration of sludge in the biochemical tank increases, mixing equipment must be added to ensure that the sludge does not deposit, and at the same time, the convective mass transfer efficiency of oxygen can be improved and energy consumption can be saved.

② Transformation of nitrification fluid return system

At present, there are two nitrification liquid reflux pumps (submersible sewage pumps) in a single biochemical tank, one for use and one for standby, and the reflux ratio is 100%. Current plans are to increase the reflux ratio to 200%. Specifically, the existing two nitrification liquid reflux pumps in a single group are removed, and 3 wall pumps are set on the wall between the oxic tank and the anoxic tank (Q = 2800 m^3/h，H = 0.7 m，N = 10.0 kW).

③ Transformation of aeration coefficient

The current aeration system is designed for a scale of 100,000 m^3/d, which does not meet the requirements of this expansion and upgrading, and has a long service life. The existing aeration system of the biological tank will be dismantled and rebuilt in this design, and 4,124 disk-type aerators (the diameter is 330 mm, and the design ventilation is greater than or equal to 3.0 Nm^3/h) will be arranged in a single tank.

④ Transformation of other parts

After the transformation, the amount of treated water in the biochemical tank has doubled, and the hydraulic conditions have changed. According to the new flow, the middle wall of the anaerobic tank and the anoxic tank was raised by a stainless-steel plate, and the height was increased by about 250 mm.

(2)Supporting System of HPB

① Carrier dosing room

The carrier dosing room is mainly used to dose the composite powder carrier into the biochemical tank, including carrier storage and dosing functions. To reduce the manual labor, an automatic feeding system is set up, and the dispensing water in the dosing room is connected to the reuse water in the

plant. The carrier is dissolved in solid, the supplementary dosage for normal operation is 3~5 mg/L, and the dosage concentration is 5%. There are altogether two sets of carriers feeding system, including automatic feeding system, dispensing tank, agitator, dosing pump and supporting control system, etc. The power of each set is about 11.0 KW.

② Carrier recovery system

A carrier recovery system is set up for the recovery of mature (with biofilm attached) powder carriers in the returned waste sludge. The biochemical treatment system with "two independent sludge residence times" can simultaneously improve the effect of nitrogen and phosphorus removal, and at the same time, the repeated use of carriers can reduce the daily carrier supplementation and reduce operating costs. The recovery system is a complete set of equipment, including supporting cyclones, lifting pumps, screens, valves, and pipelines, etc., with an operating power of about 45.0 kW. The recovery system runs synchronously with the waste sludge return system.

Figure .2 The Panoramic View of the Second-phase Reconstruction and Expansion Project of Changsha Xinkaipu Wastewater Treatment Plant

Achievements

After adopting HPB technology for upgrading and capacity expansion project, the treatment scale of the Xinkaipu WWTP expanded from the current 100,000 m^3/d to 190,000 m^3/d, and the effluent water quality has been raised from National Grade 1-A to meeting the Grade 1 of Hunan Province. The double improvement of water quality and quantity can be realized at the same time. In addition, the consumption of chemicals (PAC, PAM) during the operation was reduced by about 20% compared with the consumption before the reconstruction and expansion, which reduced the operation cost. The project saved nearly 900 million yuan for the country and about 94 mu of land. The advantages of the project are the short construction time and low operating costs, and it has significant economic, environmental, and social benefits.

The main purpose of this project is to solve the problem of water pollution and protect the ecological environment of the Xiangjiang River Basin and Guitang River. By improving the discharge standards, the pollutants discharged into the Guitang River have been significantly reduced. Meanwhile, the long-term replenishment of water to the Guitang River has effectively improved the water quality of the Guitang River, which meets the requirements of water environmental protection goals and brings significant environmental benefits. In the long run, this will improve the urban living environment and enhance the quality of urban environmental protection.

Enlightenment

The HPB technology used in this case, based on the principle of the traditional activated sludge method, changes the reaction space and time by adjusting the concentration, which breaks through the industry problem of long biochemical time in wastewater treatment. The biochemical time required for effluent to reach the "Quasi-IV" standard can be reduced by more than half, and the treatment capacity of unit tank capacity can be increased by 1 to 2 times. This technology can be flexibly adapted to the reconstruction and expansion of urban WWTP with various wastewater treatment processes. It can effectively solve the problems of difficult land acquisition and demolition, high investment cost, occuping large area, and long construction time under the current high standards of effluent water quality requirements of urban WWTP. In general, this technology has the prospect and value of widespread application.

- Street Infrastructure Improvement Project in Futian CBD, Shenzhen
- The Protective Shelter of Locality 1 Archaeological Site of Zhoukoudian Peking Man Cave, Beijing, China
- Comprehensive Improvement of Traffic Project in CBD area of Chaoyang District
- Beijing Fuchengmen Inner Street Restoration & Revival Program (1st phase)

Street Infrastructure Improvement Project in Futian CBD, Shenzhen

S.city 智慧城市集团

Shenzhen SmartCity Technology Development Group Co., Ltd.

Shenzhen Urban Transport Planning Center Co., Ltd.

Background

Futian CBD is the commercial and cultural center and important transportation hub of Shenzhen, China. Around 200,000 people are employed here, providing an average daily traffic of more than 1.34 million trips in Futian CBD. Over 10.5 million or 60% of people in Shenzhen come by the central area every month. While Futian CBD is getting busier, the street infrastructures – inadequate bicycle and pedestrian facilities, unfriendly street design, inaccessible real-time environment and insufficient event prediction – still call for smarter solutions.

Sustainable Development Goal 11 (SDG 11) is about "sustainable cities and communities". The targets of SDG 11 include improving road safety, expanding public transport with special attention to the needs of those in vulnerable situations, providing access to safe and inclusive green and public spaces, etc. Street Infrastructure Improvement Project in Shenzhen Futian CBD, led by Shenzhen SmartCity Technology Development Group Co., Ltd. (SSTDG) and Shenzhen Urban Transport Planning Center Co., Ltd. (SUTPC), renovated 5.3km² out of Futian CBD by leveraging cutting-edge technology and intelligent hardware. The project aims at optimizing traffic in Futian CBD and achieving the targets of SDG 11.

Innovative Practices

(1) Streets Reconsidered: Human-centered Design

Researchers are working with data from cyclists and pedestrians to identify patterns of movement in an attempt to design ways of improving experience for everyone on the road. An area of 9000m² in Futian CBD was rebuilt for walkways and bikeways by optimizing the vehicle lanes. Curb ramps were constructed to provide a smooth connection between the sidewalk and the road surface, aiding the crossing of pedestrians in general. The redesigns built a human-centered transport system in Futian CBD, fostering low-carbon individual modes of transport that furthers sustainable development in Shenzhen.

街道交通空间重构

(2) Environment Regeneration: Creating Green Public Spaces

Neighborhoods frame residents' lives, providing a bundle of services and an environment that people require. The project explores the nature of different neighborhoods for living use, commercial use and public use. In a total of 120000m² green spaces were reorganized to create pocket parks in Futian CBD. Those mini-parks offer innovative approaches to increase the quality of urban environment, enhance local resilience and promote sustainable lifestyles, improving both the health and the well-being of residents.

差异化街道场所

(3) Smart Transport System: Applications of Artificial Intelligence

Smart poles equipped with intelligent cameras are capable of identifying and classifying all vehicles and road users, providing accurate and highly localized data around the city. SUTPC installed 1188 smart poles and 51 smart bus stations at the major junctions within an area of 5.3km² in Futian CBD. As well as counting and classifying road users, the

行人、车流量统计

sensors can measure time it takes for vehicles to travel between junctions and provide live photos, giving planners insight into where and when roads get busy, the expected routes that motorists might take, and where parking spaces are likely to be available. A smart transport system is built in Futian CBD to form a sustainable governance and service capability of holographic perception, precise regulation and full service. The main functional applications include:

① Automated Monitoring

The smart transport systems automatically monitor pedestrians and vehicles. It supports an image processing-based detector that counts the number of objects crossing user-defined areas in the captured images.

The automated systems are capable of identifying features of pedestrians (e.g. age, clothing, holding an umbrella and riding a bicycle) and vehicles (e.g. color, size, type and plate number). It makes it easier for users to find a type of objects through searching by characteristics.

③ Pedestrian Re-identification (ReID)

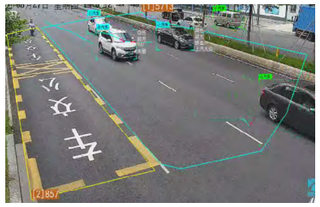
ReID uses computer vision technology to determine whether a specific pedestrian exists in an image or video sequence. The system is able to retrieve and track the same pedestrian image under different cameras.

④ Traffic Issues Detection

The system provides a real-time detection of traffic flow and incidents – including illegal driving, crashes, queues and slow-moving traffic – that might disrupt free-flowing movement on the road.

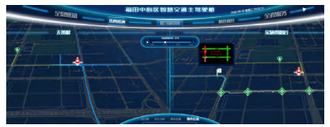
⑤ Traffic Simulation

行人结构化属性识别



车辆属性识别

行人轨迹重构



交通事件识别

The smart transport system is already predicting traffic conditions 2 hours in advance. Traffic cameras automatically detect vehicles and this information is sent back to the system where algorithms estimate the density of traffic on the road. The system then alters the traffic lights based on real-time road congestions and makes pre-timed plan according to traffic simulation.

Achievements

The project improves traffic efficiency and safety, as well as reduces energy consumption in Futian CBD, making the central area more sustainable and resilient.

Sensors at crossings, parking lot entrances and other key sites collect and process data second by second to come up with the best way to move pedestrian through the intersection. Decisions can be made autonomously, and shared with neighboring intersections to help them understand what is coming their way. It has reduced pedestrians' waiting time at intersections by up to 15%. On-demand buses have also cut commuting times by 6 minutes on average.

More than 1200 intelligent cameras were installed at intersections, roadsides, building entrances and bus stations in Futian CBD, allowing for traffic flows reconstruction with over 90% accuracy compared to what happens in reality.

The smart transport system helps to cut engine emissions by providing real-time forecasts of traffic flows and optimal routing for drivers. It keeps traffic flowing, which also reduces energy consumption caused by idling vehicles when stationary. Traffic emissions have been dropped by 1.5% and so reduce impacts on the environment.

Criteria	Changes
Pedestrians' Waiting Time	-15%
Average Commuting Times	-6 min
Traffic Offences	-10%
Traffic Emissions	-15%

Table .1 Performances

Enlightenment

Shenzhen, the pilot demonstration area of socialism with Chinese characteristics, has always been dedicated to achieving green sustainability and social sustainability. The target of this project is to create a safe, resilient and sustainable transport system in Futian CBD. Street Infrastructure Improvement Project in Shenzhen Futian CBD, led by Shenzhen SmartCity Technology Development Group Co., Ltd. (SSTDG) and Shenzhen Urban Transport Planning Center Co., Ltd. (SUTPC) provides following two aspects of enlightenment:

(1) One of the essential approaches is to connect the interdependent knowledge and skills from several subject areas. Ideas from traffic engineering, landscape architecture and smart city were integrated to improve traffic and environmental quality. A sustainable city should create an enduring way of life across different domains.

(2) Moreover, traffic management systems can become more dynamic and responsive through the use of state-of-the-art technologies such as cloud-edge computing, digital twin, knowledge graph, etc. City-wide sensors store their information and lay the foundations for intelligent traffic system in the era of big data. The data-driven systems make management more flexible and then helps cities become sustainable and resilient.

The Protective Shelter of Locality 1 Archaeological Site of Zhoukoudian Peking Man Cave, Beijing, China

清华大学建筑设计研究院
ARCHITECTURAL DESIGN AND RESEARCH INSTITUTE OF TSINGHUA UNIVERSITY

Architectural Design and Research Institute of Tsinghua University Co., Ltd.

11 SUSTAINABLE CITIES AND COMMUNITIES

Background

The Peking Man Site at Zhoukoudian was nominated on the World Heritage List in 1987 and is protected as Key Protected Cultural Heritage Site of National Significance by the National Administration of Cultural Heritage of China. The Peking Man Cave, as the exact site where the cranium of Sinanthropus pekinensis was discovered, bears the most significance of the site.

According to the data analysis of 20-year monitoring work, the Locality 1 Archaeological Site of Zhoukoudian has been threatened by severe hazards like wind and rain erosions, weathering, crumbling and instability, etc. After the severe rainstorm on 27th July 2012, the water catchment was discovered at the bottom and the west section of the cave and soon disappeared. Through geophysical prospecting, large fissures and fracture zones were found at the bottom of the cave, which endangered the overall stability of the site.

The plan of a new protective shelter was reported to the World Heritage Centre of UNESCO by the State Administration of Cultural Heritage of China in August 2013. ICOMOS approved the project in November 2013 in the replying letter.

The construction drawings were finished in November 2014 with prudence and full consideration. The construction work commenced in May 2015 and was completed in August 2018. The shelter was open to the public in September 2018.

Innovative Practices

(1)Large-Span Space Structure

Following the conservation principles of minimal interference and reversibility, a large-span space steel structure of single-layer reticulated shell is adopted to stretch across the whole Peking Man Cave, with the two rows of its stress points distributed on the top of the upland on the south and at the foot on the north, all of which locates on the flat rock mass outside the sensitive area unsuitable for load-bearing and keeps away from the site per se and the rock mass it attaches to. A minimal covered area is thus realized. During the whole construction work, all the components are pre-fabricated off-site and assemble on-site to minimize their interference to the site. It also ensures the possibility of its dismantling in inverted order when necessary to restore the original appearance of the site before construction.

(2)The Double Skin Enclosure System

The protective shelter of the Peking Man Cave, aiming to merge itself with the natural surroundings, imitates the original shape of the cave and adopts a double-skin system. The outer and inner skins are composed of rectangular leaves with 3 to 4 meters on each side. The size and angle of each leaf are parametrically calculated, verified, and rearranged by rainfall simulation software and physical environment simulation software, to secure the firmness of the connecting nodes and appropriate angles of the leaves. Therefore, the project creates an efficient drainage system while providing adequate ventilation and lighting. The objectives of this design are to prevent the Cave from rainfall, reduce wind speeds, and decrease the variation range of temperature and humidity.

Figure .1 General Layout

(3)Drainage System

The panels of the outer skin are designed on the base of parametric calculation by computer to ensure firm connection nodes and appropriate angles, so that rainfall is properly organized to be drained from the highest panel down to the lower ones. Part of rainwater will be collected in the hidden buried gutter on the north along the row of stress distribution points and drains to the current drainage system. Other rainfall will be collected in the eaves gutter on the east or west, and then drains to the north gutter mentioned above.

The drainage of the catchment beneath the Cave is also designed as an intercepting drain, locating in between the current pathway on the south and the shelter. With the landscape higher on the south and lower on the north, this intercepting drain will prevent the Cave from the invasion of overland runoff and waterfall.

(4)Materials

The double skin of the shelter is composed of aluminum panels. Planting roof techniques are applied on the outer skin leaves, while GRP panels with 3D pattern and texture imitating the precipices of the Cave are adopted on the inter skin hung beneath the steel structure.

Boardwalks with the wooden floor are designed inside the Cave under the shelter to provide pathways for visitors to observe the archaeological site, especially the cultural layers on its precipices.

All the materials are produced domestically.

(5)Planting Roof Techniques

Planting roof techniques are adopted to merge the shelter with its natural surroundings. Grooves hung on the panels help climbing plants to reduce load-bearing. They are designed at the minimal size of 300mm and 200mm for plants to survive and they are infilled with improved planting soil and filters.

Parthenocissus trcuspidata is chosen as the main type of plant for its shade tolerance and adaptation to soil and climate.

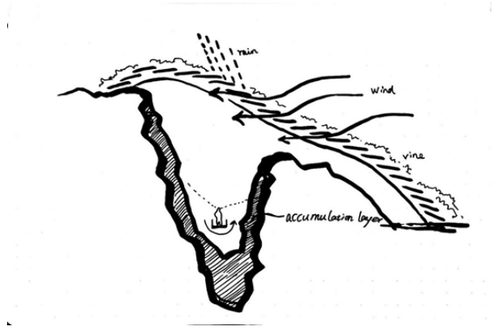


Figure .2 Design Philosophy

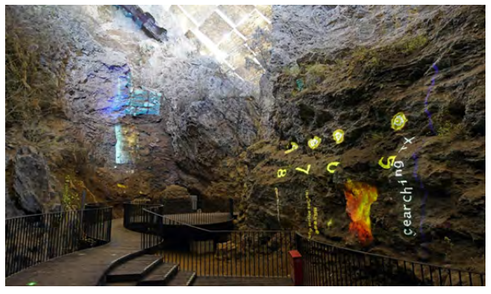


Figure .3 Internal Exhibition

Achievements

As it is aimed to minimize the interventions to the site, the double-layered skin and non-linear structure are adopted under careful calculation of natural-light efficiency. Therefore, low energy consumption is realized with natural lighting and excellent ventilation.

A Digital monitoring system is adopted in the construction process to ensure the safety of the site per se and its surrounding rock mass on the mountain.

Figure .4 Outer Skin Leaves

The original plants on the site are moved away before the construction work and are replanted into position afterward to recover the original landscape and maintain the authenticity of the historical environment.

Besides protecting the Peking Man Cave from damages caused by weathering factors and providing a proper micro-environment for the archaeologists to work on-site, the shelter also serves to explain and exhibit the cultural heritage value of the site. Illustrated information of excavation history is projected on the west precipices to explain the cultural layers on it, while the animation of hominid's life and protection history is projected on the north precipice, which enables the vivid explanation of the heritage to the public in the most efficient way.

The shelter itself, with its unique and excellent design, helps to attract much more visitors to the site, benefits the local economy, adds a sense of pride to the local people, and serves as a vivid model to explain both philosophy and knowledge of cultural heritage conservation, architectural technologies and environmental sustainability.

Enlightenment

The project is influential on both architectural practice and heritage conservational practice since it was built in 2018. It was firstly available for visiting on the International Symposium on Palaeoanthropology in Commemoration of the 90th Anniversary of the Discovery of the First Skullcap of Peking Man in 2018, at which it was visited and praised by almost all the attendees including archaeologists, heritage conservation experts, and leading figures of national governments all over the world. The compliments echoed the comments made by ICOMOS in their reply to the project report before, "Finally, ICOMOS wishes to point out that the construction plan very thoroughly prepared under the supervision of SACH is to be welcomed as a protection measure and also as an attempt to open up new perspectives for study and interpretation of the Peking Man Cave."

In 2019, the project was awarded the Golden Prize of ARCASIA Awards for Architecture for Conservation Projects. As the jury cited, "Architecture, art, archaeology, and sophisticated technology come together in this unusual design which nurtures and becomes one with the terrain and the green around it, while strictly keeping its promise to function. This semi-enclosed, single-spanned, and double-skinned structure carefully protects the precious and fragile world heritage site in its natural condition, by protecting it from the rain while allowing air and Indirect light. Keeping the concept of minimum interference and reversibility, the structure is designed to merge seamlessly with the surroundings over time." The project was also reported extensively by the relevant media.

Comprehensive Improvement of Traffic Project in CBD area of Chaoyang District

北京市市政工程设计研究总院有限公司
Beijing General Municipal Engineering Design & Research Institute Co., Ltd.

Beijing General Municipal Engineering Design & Research Institute Co., Ltd.

11 SUSTAINABLE CITIES AND COMMUNITIES

Background

Beijing CBD is a diversified business center and the home to many international high-end enterprises. It is a landmark area of Beijing's modern city image. At present, most of the traffic conditions and street landscape in the CBD area are inconsistent with the overall outlook of Beijing CBD, including traffic congestion and disorder, illegal parking occupying pedestrian space, slow space discontinuity, uneven quality of the street landscape, and a lack of high-quality public space, etc. The project takes the 4 km^2 area of the western CBD as the renovation subject, involving 36 municipal roads with a total length of 26.77 km. The project aims to recreate a world-class CBD and adheres to a people-oriented, scientific-oriented, and innovative philosophy. It also strives to create a public realm with slow traffic priority, orderly traffic, local characteristics, and a high-quality landscape, to improve the sense of happiness and gain of urban residents' life, and to realize sustainable and healthy development of the city.

Innovative Practices

As an urban renewal and reconstruction project with an extremely special location, the following strategies are mainly adopted in terms of traffic environment governance. Firstly, building a regional integrated slow traffic system based on people. Secondly, improving the road network and the efficiency of regional traffic operation by extending and opening up to smooth traffic microcirculation. Thirdly, renewing traffic facilities to improve road safety. Fourthly, introducing technical appliances to develop an urban intelligent traffic model. Specifically, the project includes the following practices: remolding roadway and pedestrian paving, replacing curbstones, reinforcing the roadway inspection wells, updating traffic signs and guardrails, applying the new traffic science and technology system, upgrading management platforms, and introducing the appliance of 5G network.

Figure .1 Renovation of Pavement and Traffic Facilities

In the aspect of street landscape improvement, the design goal is to create a vivid block that integrates greenery, art, business needs, and urban life for the Beijing CBD. Four design strategies are proposed. First, it advocates slow traffic. The walking environment is optimized by improving and constructing a continuous and comfortable slow traffic system of the avenue. The second is to achieve an integrated space along the street. The pedestrian street and the building backlines are designed as a whole to enhance the auxiliary functions of the road space. The Third is to integrate and upgrade the green space along the street to carry out the organic weaving of the street. To achieve this, pocket parks are implanted in key areas and the public activity space of the block is enriched. The fourth strategy is to refine the design elements, strengthen the artistic details, and enhance the identifiability in order to align with the CBD's cultural characteristics and overall style. Detailed work including reorganizing the underground municipal system to reveal the urban skyline and interface, landscape upgrading, pocket park implantation, pedestrian pavement renovation, integration of the green space along streets and the front space of business buildings, street trees and shade improvement, artistic design of the crossroad waiting area, etc. Public guidance and street furniture have been renewed aesthetically, including the road signs, parking plates, business bus indicators, and direction poles, etc.

Figure .2 Integrating the Green Space Along the Street

Figure .3 Refined and Artistic Design of Sidewalks

Achievements

The Comprehensive Improvement of Traffic Project in the CBD area of Chaoyang District has achieved remarkable results. Through traffic control and landscape renovation, the project has implemented the concept of slow traffic priority by improving the service facilities for slow and smart traffic appliances. The project has realized the standardized management of shared bikes in the whole area. It utilizes innovative equipment like the multi-functional traffic poles, the safety island of "twice crossing the street", bicycle shock line marking, electronic fence of shared bikes. The clear traffic signs are specially marked on the clean streets.

Figure .4 Implanted Pocket Park at Street Corner

Detail is the key to the project. Manhole covers on the sidewalks have been replaced with invisible covers, the urban furniture on the sidewalks has also been unified with an "elegant gray" coat, and road signs are written in both Chinese and English to manifest the international trait of the area. This project has created a new CBD streetscape with both pleasant greenery and cultural connotation. Through the concession of architectural space and green space integration, the central business area has a newly built greenery of 6,000m^2 with 6 new pocket parks. In addition, the introduction of traffic technology has achieved an intelligent traffic system and fine

Figure .5 Shaded Road and Block

Now CBD's traffic environment has provided a pleasant and comfortable slow-walking experience, high-quality street landscape, and healthy and sustainable development of the city, adding more happiness for urban residents.

Enlightenment

Urban traffic and street environment renewal often has strong particularity and complexity, which are reflected in the following aspects,

(1) Restrict Constraints

The role of streets in the city, their scale, and their dimensions restrict the renewal of the streetscape. Meanwhile, land use on both sides of the road and the building itself could not be easily modified, to which, great importance has to be attached in order to properly adapt.

(2) Complex and Focused Design

The renovation of the streetscape is a very delicate job. Therefore, in addition to some integrated works, it is necessary to clear the specific renovating tasks which are strongly targeted.

(3) Linear Space

The project focuses on the linear space which strengthens the characteristics of extension, efficiency, continuity, coordination, yet unique and distinct.

(4) Communication and Coordination

The implementation of this project demands coordination. In the practice, it is found that different renovation aspects belong to separate departments, and also involves the rights and interests from various perspectives. It is vital to strengthen communication and coordination among each party to achieve an optimal upgrading scheme.

Beijing Fuchengmen Inner Street Restoration & Revival Program (1st phase)

中国建筑设计研究院有限公司
CHINA ARCHITECTURE DESIGN & RESEARCH GROUP

China Architecture Design & Research Group

11 SUSTAINABLE CITIES AND COMMUNITIES

Background

Fuchengmennei Street in Xicheng District in Beijing is an ancient street in the core zone of the city with more than 700 years' history. It is the major road to enter the Forbidden City from the west side via Fucheng Gate since the Yuan, Ming and Qing Dynasties. This street hasn't changed at all since its creation during the Yuan Dynasty and over the past centuries it became the major roadway that connected east and west in the old city. Many alleys, lanes, archways and historical buildings on both sides of the street were all constructed during the Ming and Qing Dynasties. These include Guangji Temple, Guojun Palace, etc. They were all maintained well and contained precious culture value. With the rapid development in the Capital, the traffic multiplied, the population massively increased, as well as the industrial transformation upgrades, the existing space of the old city has been already difficult to meet complicated ever-changing functional requirements currently. This makes the urban living experience worse and worse. Organized by Beijing Municipal Government and Xicheng District Government, Funei Street Restoration & Revival Program targets on protecting and displaying the style of the historical capital, upgrading the residents living quality and keeping healthy development with low maintenances, focuses on the Block upgrade & exploring all-round practices from municipal traffic, building façade along the street, public area, nightscape lighting, Block Greening, street furniture, supporting facilities etc.

Innovative Practices

Firstly, we established a community platform, where stakeholders can effectively communicate and interact with each other during the course of this project. In neighborhood renovation projects, decision makers (local government), executors (architects & contractors) and the users (general public) usually have different opinions. In order to achieve maximum benefits to the community, it is crucial to accommodate all stakeholders' interests and concerns. Therefore, together with our expert consultant team and management team, on our community platform, we tried our best to promote efficient communication and to consider all different views. We made an exhibition hall based on the building facing the street (# 161 Funei Street), where the community residents and pedestrians could visit and acknowledge the program at anytime. They could also write down their suggestions to the decision maker. The local government organized regular meetings with representatives from the residents, companies on this street as well as all the construction groups to provide comments and suggestions.

Secondly, we made necessary adjustments to public spaces based on their economic value. Unreasonable and scattered fixtures, together with unpopular labels, were removed to free up spaces for more plantation, amenities, and facilities with local cultural elements.

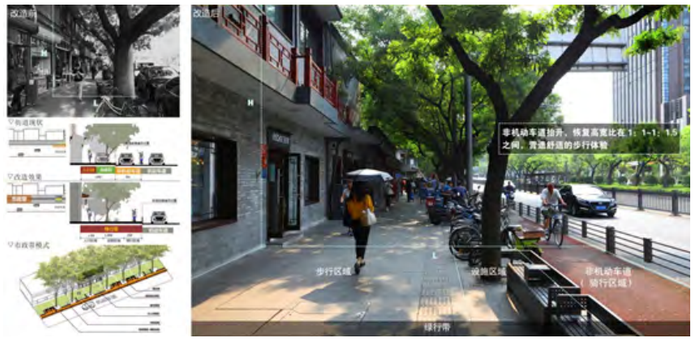


Figure .1 Current Condition of the Street

Thirdly, we closely followed the problem-solving process in finding the optimal solution. After conducting thorough examination of the site, our designers classified the problems encountered into the following categories: transportation, landscape, dimension, etc. As soon as we came up with the best suited solution, it was debated and modified on our community platform until unanimity was reached.

Fourthly, our designers were on the site for the whole course of the project to find out and correct mistakes, take advice, and improve and optimize plans.

Regarding to some identified problems, we had the following proposals: Adjust parts of the arrangement of parking space and non-motorized vehicle driving space to create a designated lane for non-motorized vehicles to separate pedestrians from non-motorized vehicle traffic; Tear down unnecessary facilities (railing, outdated installations), integrate existing functional facilities (utility pole, road signs), eliminate underused space (overly spaced bus stops, oversized electrical box), and expand safety exit, amenity space, and recreational area; Increase roadside plantation and green plot ratio to reserve a contingent space for flexible future modification; Set clear boundaries to separate pedestrian and vehicles by using railing, plantation, and other installations for better roadside management and traffic flow; Protect and preserve buildings or structures which reflects of cultural and architectural history.

Figure .2 Adjustment of Transportation

Achievements

(1) Long-lasting Construction Effect

We have achieved remarkable results of continuous shade trees, pedestrians and vehicles going their own way, accessible barrier-free facilities, expanded public space, and corresponding improved amenities. According to statistics, after the renovation, the number of single tree and shrub increased by147%, green plot ratio has a 30% increase, utility pole decreased by 70%, public space expanded to 1263 squared meters. Most of the new public space was used as greenspace, a reserve land for future development.

Figure .3 Evacuation Construction Effect

(2) Long-lasting Operation and Maintenance

Our team have frequently visited the site since the completion of the project two years ago. With the maintenance budget under control, the effects of project on the neighborhood including better amenities, increased traffic efficiency, lower number of traffic accidents all exceed our expectations.

Figure .4 Replanting and Greening

(3) Long-lasting Social Impact

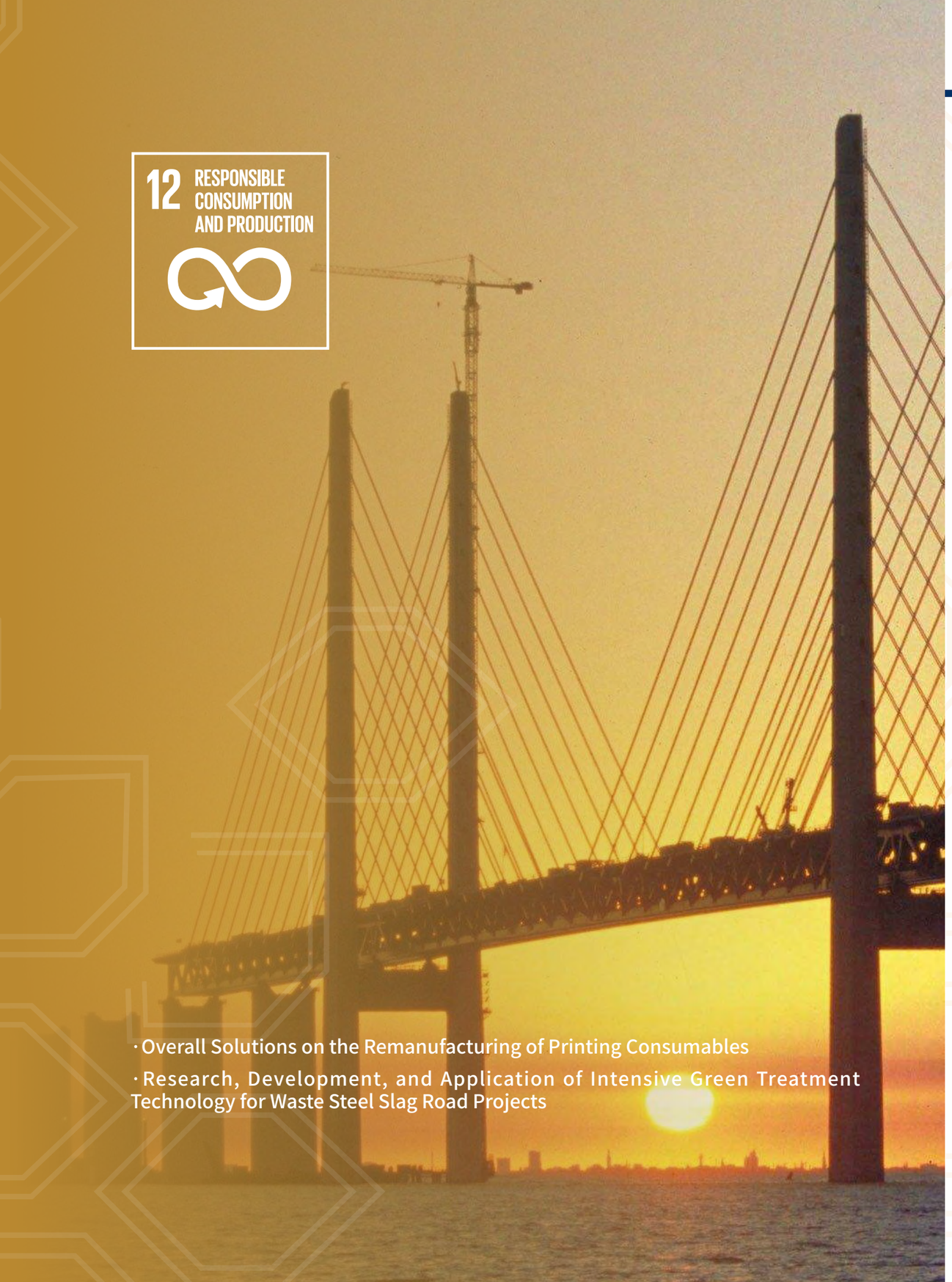
On the aspect of academic research, Funei Street 1st phase project, as the typical case, has been listed into the Block Design Guide Principle of Beijing city and Xicheng District. This provides the reference for the urban renovation of the Capital core zone. It received IFLA Asian Pacific Honor Award in 2020 and has obtained a Utility Model Patent. On the aspect of social appraisal, the majority of experts and resident representatives confirmed the renovation. Many upcoming renovation projects in the old city have referred and promoted those creative modes in this program including the integration multi-functions in less utility poles, the combination of many small bus stops into several major stops, comprehensive space utilization surrounding the Metro as well as Cultural Implementation into municipal facilities.

Enlightenment

To promote the construction of a harmonious block with fair open attitude. This is one of the successful program implemented by Beijing government, which promoted the citizens to participate in the management of the local blocks. During the whole process of the program, it has been displayed to the public based on the open and transparent principle, meanwhile it built up the communication platform to let the residents have a fair and open conversation, in order to fully encourage and inspire them to participate in this process of city construction, which creates the mode for people to contribute their comments and suggestions to develop the community.

To standardize and guide the healthy development of the public order via design means. The program implementation proved that the ingenious designs could indeed control and guide effectively the flow of pedestrians and traffics, the placement of verticals and facilities, as well as the maintenance of public health consciously into the tidy, standard, well-regulated development, with no increasing in late operation cost.

To promote the upgrade of the format via environment quality. The program had broken the previous single mode which adjusted the format via economic compensation. The well-regulated, tidy, clean and beautiful environment give the inconvenients to the inappropriate format, then such could push its natural succession and evolution of the urban format, all these provide another updated good solution for the Decision Maker.



12 RESPONSIBLE CONSUMPTION AND PRODUCTION

- Overall Solutions on the Remanufacturing of Printing Consumables
- Research, Development, and Application of Intensive Green Treatment Technology for Waste Steel Slag Road Projects

Overall Solutions on the Remanufacturing of Printing Consumables

SPEED Green the Future

Beihai Jixun Electronic Technology Co., ltd

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Background

In 2017, the National Development and Reform Commission of China, in conjunction with relevant departments, issued the Circular Development Leading Action proposing to support the industrialization, standardization and large-scale development of remanufacturing. In 2021, the National Development and Reform Commission of China issued the 14th Five-Year Plan for Circular Economy Development which deployed six key actions on the high quality development of the remanufacturing industry and the recycling of waste electrical and electronic products. China is the world' s production base for printing consumables occupying 21% of the global market share of toner cartridges, 29% inkjet cartridges, 14% toner, 69% ink and 40% inkjet media. The annual output value of printing consumables is almost 100 billion yuan, of which remanufactured consumables account for about half. At present, the technical research work in remanufacturing field in China is mainly concentrated on large and medium size equipment such as automobile engines, gearboxes, and electromechanical products, and the related research on the remanufacturing of printing consumables is relatively weak.

Printing consumables refer to products such as inkjet cartridges, toner cartridges, ribbons, wearing parts and common accessories that are used in copiers, printers, fax machines and other office Equipment. Consumables remanufacturing refers to the recovery of waste printing consumables to the same technical performance and product quality as the original products after dismantling, cleaning, testing and sorting, remanufacturing, assembling and retesting. Remanufacturing of printing consumables is an emerging industry with high resource value, significant environmental benefits and sustainable development. It can effectively meet the needs of the development of circular economy and is an important form of the industrialization of circular economy in China. According to research data, compared with the production brand-new consumables, producing one remanufactured printing consumables can save Energy by about 95%.

Innovative Practices

Through continuous growth, the project has built a globalized industrial closed-loop model that covers the recycling, remanufacturing and sales of printing consumables, including an efficient recycling system, self-developed automated production lines and online and offline sales mode. The model ensures the overall sustainable operation of the industrial chain. Beihai Jixun Electronic Technology Co., ltd has established functional centers such as R&D, production, procurement, sales, marketing and service, forming a fully functional group development system. In Beihai, the company has set up a R&D center with a professional ink R&D team and a remanufacturing factory with 100% independent R&D equipment and 600 employees, covering an area of 15,000m^2. The company has set up a purchasing company in Hong Kong, a sales company in Shanghai, and a sorting company called Speed Infotech Czech S.R.O. in Czech Republic, Germany CR-Solution recycling company, acquired the RECOLL Company under ARMOR, which has 25 years of consumable recycling experience. In addition, the company has more than 8,000 recycling points in Germany, Poland, Czech Republic, North America, India, Malaysia, Philippines, Japan, Indonesia and other countries. Remanufactured products are mainly sold to France, Germany, Poland, Italy, the Netherlands, the United Kingdom, the United States and other countries.

Achievements

(1)Environmental Benefits

If the waste printing consumables are directly discarded or landfills, they will not only occupy land but also cause pollution. After overall remanufacturing or parts remanufacturing, printing consumables and their parts can be reused 2-3 times or even multiple times, and the hazardous substances remaining in the consumables can be treated in a harmless manner. Over the years, the project has recycled 150 million printing supplies, reduced oil consumption by 57 million liters, and protected 5.6 billion tons of water and 10,000 cubic meters of land from pollution.

(2) Social Benefits

The project’s exploration in the field of ink cartridge remanufacturing provides a new development direction for the development of China’s remanufacturing field, which is conducive to promoting the recycling and reuse of China’s printing equipment and printing consumables. Relying on the demonstration effect of the project, the Beihai Comprehensive Bonded Zone has successfully created a global import processing /remanufacturing demonstration zone for Beihai high-tech products. The park has gathered a number of remanufacturing companies with a total output value of more than 3 billion yuan. Circular economy and remanufacturing industry show a trend of agglomeration development. The closed-loop industrial model with a global layout also provides a new development model for related remanufacturing companies and at the same time creates new business opportunities and employment opportunities at home and abroad. Enterprises attach great importance to the development of industry-university-research cooperation with universities and associations, effectively promoting the development of industry-university-research cooperation in the remanufacturing industry, greatly stimulating the potential for the transformation of scientific research results of universities, and contributing to the technological progress and industrial model upgrading of the remanufacturing industry.

(3) Economic Benefits

The project mainly produces remanufactured printing consumables, the production cost is only 20%-50% of the brand-new product, and the price is only 50%-70%. Most of the remanufactured products are exported to Europe, America, Southeast Asia and some of the products enter the supermarket chains and e-commerce platforms of various countries to meet the printing needs of customers in more than 100 countries and regions around the world. In Europe alone, more than 9 million waste printing consumables can be recycled throughout the year, with a market price of more than 22.5 million euros. Cumulative cost saving 128 million euros.

Enlightenment

Global consumption and production promote the development of global economy, but it depends on the utilization of natural environment and resources. The current utilization mode will continue to have a destructive impact on the earth. Therefore, in the 2030 Sustainable Development Goal of the United Nations, "adopting sustainable consumption and production mode" is proposed. As an enterprise, it is necessary to use resources reasonably and effectively in the production process and make full use of renewable resources, so as to promote the sustainable development. Taking into account the widespread use of home printers by consumers in the post-epidemic era and the habits of throwing waste for consumers in various countries, the recycling channel of printing consumables suitable for various countries has been established by Beihai Jixun Electronic Technology Company according to local conditions. According to the successful implementation results of the recycling plan in Germany, as well as the reproducibility of supporting equipment and personnel allocation, it can be gradually replicated and promoted in other countries with the same level of development.

In the next three years, the project will further integrate recycling resources to expand market share, improve the recycling system composed of recycling points and sorting centers, and extend mature closed-loop business models to China, the United States, Japan, Southeast Asia and other European countries in accordance with local conditions and regions. At the same time, the project will launch the Industry 4.0 plan to introduce intelligent manufacturing technology for the remanufacturing process, and is committed to building a digital factory and comprehensively deploying the printing consumables remanufacturing business, so that the project's annual operating income will maintain a steady growth.

Research, Development, and Application of Intensive Green Treatment Technology for Waste Steel Slag Road Projects

School of Transportation Southeast University,
Wuxi Municipal Facilities Construction Engineering Co., Ltd.,
Jiangsu Shagang Group,
Jiangsu Xianda Construction Group Co., Ltd.

Background

Steel slag is the by-product of the steel-making process. By the end of 2020, the accumulated stockpile of steel slag tailings in China was nearly 2 billion tons, covering an area of more than 200,000 mu (about 133,333,333 square meters). However, the harmless treatment rate and the resource utilization rate of steel slag in China are low, which not only occupies a large amount of land but also causes environmental pollution and resource waste. At present, the steel slag is mainly utilized in cement and concrete formulation, roads and sponge cities construction, and soil improvement, where the road construction includes the construction of roadbed, water-stable layer, and asphalt pavement, and repair to the pavement, etc.

In recent years, President Xi Jinping's "two mountains metaphor" gradually wins support among the people. It says "we want to have not only mountains of gold but also mountains of green. If we must choose between the two, we would rather have the green than the gold. And in any case, green mountains are themselves gold mountains". As a response, various regions in China continue to introduce policies to restrict sand and gravel mining, which makes the demand for natural aggregate substitutes for road construction increasingly urgent as aggregates produced from natural stone are more expensive and difficult to purchase. Steel slag crude material with rough texture, rich angularity, and good hardness can be used as road aggregate after stabilized treatment, while steel slag fine material can be used as cement admixture and for soft soil curing projects after grinding, thus realizing the high-value resource utilization of steel slag.

In 2020, China's National Development and Reform Commission and the Ministry of Industry and Information Technology jointly issued the Notice on Promoting the Gathering and Development of Comprehensive Utilization Industry of Bulk Solid Waste, which proposes among the key tasks that actively promote the in-depth research, graded utilization, high-quality and superior use and large-scale utilization of steel slag and tailings, promote products with advanced technology, low energy consumption, high slag consumption, and high added value, and fully realize "zero-emission" of steel slag. However, there are the following challenges in steel slag applications in specific engineering cases:

(1) There is a risk of groundwater contamination by steel slag powder's precipitation of toxic metal elements. Also, the powder's insufficient gel composition and limited strength enhancement for soft ground treatment limit its large-scale promotion and application.

(2) There are significant differences in density and granular properties between steel slag and natural stone aggregate. The strength formation mechanism of the mixture remains unclear when the steel slag aggregate is used for pavement asphalt or cement concrete.

(3) The steel slag microwave thermal induction efficiency is low. As a result, the effectiveness of pavement de-icing and self-healing of the steel slag aggregate mixed asphalt concrete pavement is not significant.

(4) In road construction, the free calcium oxide (f-CaO) existing on the surface of steel slag may swell, causing water damage. Also, the amount of asphalt for pavement will be significantly increased because of the porous nature of the steel slag surface, which increases costs.

It is against the above background and for the demand of road engineering application that School of Transportation Southeast University, in cooperation with Jiangsu Shagang Group, Jiangsu Ruiwo Construction Company Limited, Wuxi Municipal Facilities Construction Engineering Company Limited, and Jiangsu Xianda Construction Group Company Limited carried out research and development of steel slag green treatment technology and practice of road engineering application.

Innovative Practices

(1) Considering the risk of steel slag being used to leach toxic elements in road subgrade during service, magnetic minerals and non-magnetic minerals are separated by grinding steel slag and wet magnetic separation treatment. The secondary steel slag and attapulgite are mixed together, and many kinds of heavy metals in the steel slag are complexed, bound by ion exchange, electrostatic and adsorption, so that the toxic heavy metal elements are deactivated and fixed and adsorbed in the attapulgite. The secondary pollution of the environment is completely reduced.

(2) Aiming at the lack of gel activity of steel slag, based on the idea of reconstruction of steel slag and the rate value control method of cement raw meal firing clinker, a novel composite substrate of steel slag composite substrate for foundation reinforcement with metakaolin and lime at room temperature was developed, which greatly improves the strength of steel slag by adding the composition and active excitation (Fig. 1).

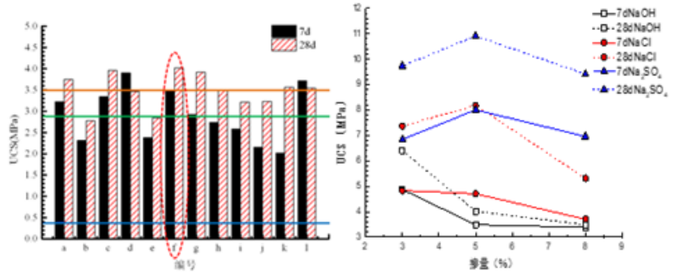


Figure .1 Test Results of Steel Slag Composition Filling (left) and Active Excitation (right)

(3) To solve the problem of low microwave thermal induction conversion efficiency of ordinary steel slag, the steel slag was magnetized by chemical coprecipitation and activated carbon reduction process, and replaced some or all of the coarse and fine aggregates in the conventional asphalt mixture. The surface of the modified steel slag asphalt mixture can be heated uniformly, and the heat can be transferred to the coated asphalt layer quickly and uniformly, as shown in Figure 2.

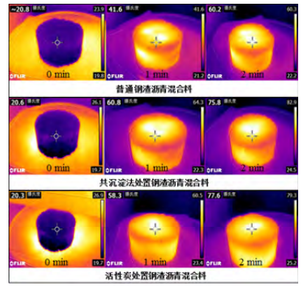


Figure .2 Infrared Thermal Imaging Results of Ordinary and Disposed Steel Slag Asphalt Mixture

(4) To solve the problems of non-uniform microwave absorption caused by the dispersion, precipitation and spatial distribution of ordinary and modified steel slag in asphalt mixture, a chemical reaction-based microwave absorption enhancer was invented to improve the microwave utilization ratio and heat transfer efficiency, which causes the steel slag aggregate to attach a layer of magnetic nano-Fe3O4 material to the surface of the steel slag aggregate and ensures that the dissipation of microwave energy is concentrated in the surface film layer. The rapid heating of the surface (i.e. asphalt film) under microwave irradiation is realized.

(5) In view of the disadvantages of the long natural aging cycle and the high cost of treating steel slag to prevent expansion, a two-component condensation room temperature vulcanized silicone rubber emulsion hydrophobic coating was developed based on the hydrophobic mechanism of reducing the surface energy of the material (Fig. 3). Through immersion treatment, the hydrophobic coating solidifies into a film on the surface of the steel slag, prevents the contact between the steel slag and water, and suppresses the volume expansion of the steel slag. The solidified film also closes the small gap on the surface of steel slag, and effectively reduces the amount of asphalt in the steel slag-asphalt mixture.

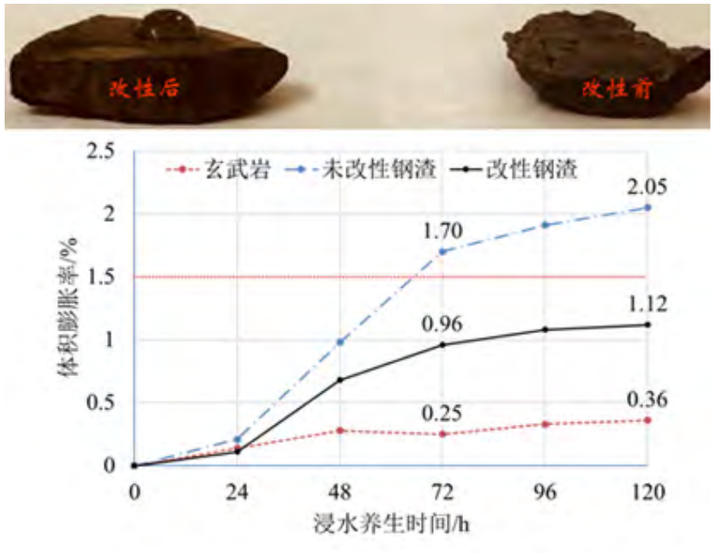


Figure .3 Test Results of Water Droplet Contact Angle (top) and Water Swelling (bottom) After Surface Modification of Steel Slag

(6) Considering the variations in aggregate extrusion strength caused by steel slag replacing part of the natural stone in asphalt concrete and cement concrete, taking aggregate (steel slag and natural stone) as a single variable, a mixture skeleton strength evaluation system based on skeleton penetration test and strength model is established to realize direct evaluation of skeleton strength.

Achievements

(1) After extensive laboratory testing and adaptation of the process for outdoor use, Jiangsu Shagang Group Co., Ltd. has set up a steel slag aggregate production line for road construction with an annual processing capacity of 500,000 tons, and realized the stable treatment process of various nominal particle size aggregates of 0-2.36 mm, 2.36-4.75 mm, 4.75-9.5 mm, 9.5-13.2 mm and 9.5-19.0 mm.

(2) The secondary steel slag modified soil subgrade disposal technology has been widely used in the disposal of soft soil in Zhejiang and Jiangsu Province (implemented by Jiangsu Ruiwo Construction Group), which greatly reduced the construction cost of the project and the disposed soil subgrade fully met the performance requirements.

(3) The microwave heating technology of steel slag asphalt pavement has a remarkable effect on the treatment of rutting diseases on trunk roads, and the service life of the road can be effectively improved after repair.

(4) Steel slag aggregate was used in each layer of cement stabilized macadam base course and asphalt concrete surface course (Wuxi Municipal facilities Construction Engineering Co., Ltd.). The performance of the road is good, and the overall structural strength of the pavement is improved and the project cost is reduced at the same time.

(5) The permeable concrete pavement made of steel slag was used in the road system of sponge city (implemented by Jiangsu Xanda Construction Group Co., Ltd.). The cost of permeable cement concrete with 40% steel slag is 28.9% lower than that of basalt permeable concrete, and the strength values are better.

In short, the developed highly efficient and comprehensive steel slag utilization technology enables large-scale application of steel slag waste with high added value. In the past two years, the sales of steel slag series products have been increased by 97.04 million yuan, the profit will be increased by 29.94 million yuan, and the tax revenue will increase by 7.85 million yuan. The steel slag will be used to replace traditional materials in the construction of the above-mentioned road construction test track, which will reduce the direct construction cost by about 30 million yuan and the economic benefits will be very large.

Therefore, the large-scale use of steel slag in road construction solves the urgent need for steel slag accumulation in steel mills, saves a lot of land occupation and eliminates the influence of accumulation on underground water sources; in addition, steel slag replaces the resources for road construction, greatly reduces the dependence of road construction on natural resources, promotes the environmentally friendly development of the steel and transportation industry, and brings invaluable social benefits.

Enlightenment

Considering the urgent treatment pressure of steel slag solid waste accumulation and the serious shortage of resources for road construction in road engineering, an integrated innovation architecture system of "mechanism explanation, function disposal, optimization design and application technology" is proposed for the application of steel slag in road construction. The main innovations are as follows:

(1) Through the research and development of the reconstruction, addition and excitation technology of the active components of the secondary steel slag, the harmless, stable and efficient disposal of the secondary steel slag subgrade soil can be realized;

(2) The research and development of steel slag magnetization treatment and nano-Fe3O4 magnetic material film technology can greatly improve the efficiency of road disease repair and reduce the energy consumption and carbon emission for maintenance;

(3) The steel slag expansion suppression technology and skeleton strength evaluation method are put forward to provide technical support for the gradation design and strength improvement of steel slag asphalt concrete / cement concrete.

This case breaks through the technical bottlenecks such as the level, proportion and efficiency of the application of steel slag in road construction, and realizes the innovation and progress of the application technology of steel slag in road construction. The results of the project are of far-reaching significance in improving the utilization rate of resource recycling, reducing the environmental impact of steel slag accumulation and exploitation of resources in road construction, and promoting the road transportation industry to achieve the goal of "carbon neutralization". The highly efficient and comprehensive technology of steel slag utilization can give a new direction and strength to many iron and steel enterprises in China and even worldwide to solve the problems of steel slag accumulation and environmental pollution.

13 CLIMATE ACTION

· Recycling of HCFCs and HFCs refrigerants

Recycling of HCFCs and HFCs refrigerants

Tianjin Aohong Environmental Protection Material Co. , LTD

Background

The widely used HCFCs and HFCs refrigerants, once leaked from the refrigeration system or discharged into the atmosphere with the maintenance and scrapping of refrigeration equipment, can affect climate change through subsequent photochemical reactions. HCFCs have the dual effects of ozone depletion and the greenhouse effect. Although HFCs have no ozone depletion effect, the greenhouse effect is significant. The global warming potential of most of these two types of refrigerants is thousands of times of that of carbon dioxide. According to The Montreal Protocol and the subsequent Kigali Amendment, countries around the world are actively responding. China is the world's largest producer and consumer of these two types of refrigerants, accounting for about 70% of the global production and 40% to 50% of the usage. We can calculate that there are more than 3 million tons of these two types of refrigerants in refrigeration equipment in China at present (the previous emissions have been deducted), and about 3 million tons of these types of refrigerants will continue to be put on the domestic market in the next 20 years. These combined 6 million tons of refrigerants, if emitted, will amount to about 12 billion tons of CO_2 equivalent. It is important to reduce emissions of these refrigerants over the next 20 years or more. Therefore, efficient recycling of these refrigerants can greatly reduce emissions and mitigate the impact of climate change.

13 CLIMATE ACTION

Innovative Practices

Taking Tianjin Aohong Environmental Protection Material Co., LTD as the demonstration base for refrigerant recycling, Aohong Group actively conducts scientific research around recovery modes, regeneration treatment technologies, and reuse tests, and has obtained more than 30 patents and a number of scientific and technological awards. This project is the initiative in China. Aohong works closely with Tsinghua University, Nankai University, Solid Waste and Chemical Management Center.MEE, China Household Electric Appliance Research Institute, China Electronics Engineering Design Institute, China Automotive Engineering Research Institute, and some other universities as well as other institutes to develop technologies for the recycling of refrigerants in waste refrigeration equipment and containers. Aohong has also cooperated with China National Resources Recycling Association, China Association of Circular Economy, China Refrigeration And Air-Conditioning Industry Association and other associations to carry out technology promotion, with remarkable results.

The principle of refrigerant recycling is to use a recovery machine to suction the refrigerant from the scrapped or to be repaired refrigeration system into a cylinder, which is generally composed of a fully enclosed compressor, condenser and filter. After subsequent purification treatment processes such as oil removal, non-condensable gas removal, moisture removal, impurity removal, re-proportioning, etc., the recovered refrigerant will be restored to a qualified state and reused to avoid the direct discharge of refrigerant into the atmosphere to cause air pollution.

Waste refrigerant purification technology is a process in which special equipment is used to cyclically filter the recovered refrigerant to remove non-condensable gas, oil, water, acid, and other impurities, so that recovered refrigerant can be reused. The process mainly includes purity testing and purification operation. The mixture of different refrigerants needs to be separated by fractional distillation. Then, after the deacidification and dehydration process, the regenerated refrigerant is guaranteed to meet the standard and enters the storage container.

The development and application of refrigerant recycling technology aim to realize the regeneration treatment of waste single-component refrigerant or mixed refrigerant, so that the waste refrigerant can be restored to the same physical and chemical indicators of the original refrigerant and can be reused.

The main technical performance indicators are:

Product purity: ⩾ 99.8%;
Recovery rate: ⩾ 95%;
Moisture content: ⩽ 10mg/L;
Non-condensable gas content: ⩽ 1.5%.

Achievements

The development and application of waste refrigerant recycling technology meet the requirements of relevant national environmental protection policies. The main purpose is to solve the social problems of environmental pollution caused by inefficient recycling of waste refrigerants and to save energy as well as reduce emissions.

Through innovative management mode, green management and recycling of the whole life cycle of refrigerants including design, procurement, production, transportation, storage, sales, use, recycling have realized the minimization of pollution and the maximization of resource utilization.

The project has been industrialized and promoted in Taicang factory, Guangzhou factory, and Japan factory of Aohong Group. After nine years of work, more than 2,500 tons of these two types of refrigerants have been recovered, which is equivalent to 5 million tons of CO_2 emission reduction. The recycling volume has increased from 20 tons per year to more than 1,000 tons per year, which is equivalent to 2 million tons of CO_2 emission reduction.

At present, the waste refrigerant recycling industry in China is still in its infancy. Although there are more mature technologies in developed countries, the market there is too dispersed. China's market is relatively large, but it lacks the application and promotion of this technology. Aohong will further optimize the refrigerant recycling technology, improve the industrial scale, and formulate relevant working standards to minimize pollution and maximize resource utilization. Through project implementation, we will accelerate the construction of an innovative technology service system and enhance the function of technology services to promote climate action.

Recycling the refrigerants can reduce the amount of newly produced refrigerants, as well as reduce the waste of resources and the use of energy, and it is also a powerful measure to reduce carbon emissions.

Enlightenment

So far, climate change remains to be one of the most severe challenges in the world. In 2015, the world leaders with the greatest political determinations and wisdom promoted the adoption of the Paris Agreement on climate change. The COVID-19 pandemic today has reminded us of the relation between man and nature, drawing more attention to the future of global climate governance. The recycling of HCFCs and HFCs refrigerants is a crucial innovation for energy conservation and emission reduction as well as efficiency improvement. The current amount of refrigerants recycled by Aohong only accounts for less than 1% of the estimated recoverable refrigerant market in China. With a continuous emphasis on climate action, the Chinese government has brought up the 2035 carbon peak target and 2060 carbon neutrality target. Therefore, the application and development of the recycling technology of the HCFCs and HFCs refrigerants will be of great value. It is expected that in 3-5 years, Aohong will recycle 5,000 tons of refrigerants each year, which is equivalent to an annual emission reduction of 10 million tons of CO_2. The technology of this project meets the national environmental protection needs and strategic development direction, filling the gaps in the domestic recycling technology and industry, and will make a significant contribution to the global climate environment.

14 LIFE BELOW WATER

· Construction Project of Ecological Environment Intelligent Remote Sensing Management Platform in the West Coast New Area of Qingdao

Construction Project of Ecological Environment Intelligent Remote Sensing Management Platform in the West Coast New Area of Qingdao

SenseTime Technology Development Co., Ltd.

14 LIFE BELOW WATER

Background

Ocean drives many of the global systems that make the planet habitable. Essentially speaking, rain, drinking water, weather, climate, coastlines, a variety of food, and even oxygen in the air for human to breathe are provided and regulated by the ocean. Protecting Marine resources and the diversity of marine life is vital to the health of people and the planet. The construction and protection of coastal ecosystem are closely related to the sustainable utilization of marine resources. Coastal ecosystem plays a buffer role and can effectively prevent any damage to the ocean. Qingdao West Coast New Area of Shandong Province, China, is located in the southwest of Qingdao, covering a land area of 2,096 square kilometers and a sea area of about 5,000 square kilometers. It harbors 282 kilometers of coastline, 83 square kilometers of the beach area, 42 islands and 23 natural harbors along the coast. And it is rich in marine resources. The Management Committee of Qingdao West Coast New Area put forward requirements in The 13th Five-Year Plan for Ecological Urban Construction and Environmental Protection of Qingdao West Coast New Area (Huangdao District) to strengthen comprehensive management and control of environmental risks in key areas, and constantly enhanced the ability to protect the environment by improving the ecological environment monitoring network, improving environmental early warning and detection, and comprehensively promoting the construction of a smart environment. SenseTime cooperated with Qingdao West Coast New Area to build an integrated ecological and environmental governance system featuring "large platform, big data and large system", and advanced the strategic transformation of environmental management by informatization.

Innovative Practices

SenseTime promoted the deep combination of artificial intelligence, big data technology, remote sensing technology and Internet of Things technology, which effectively solved the problems of low efficiency and low precision of existing ecological environment monitoring and supervision and created a new model of "intelligent+ecological environment supervision".

(1) Construction of the Ecological and Environmental Big Data Resource System

Through the sorting, cleaning and processing of ecological and environmental data from different sources, the integration of data resources is completed in accordance with unified standards. Based on the regional data sharing and exchange platform, the exchange and sharing of data between different departments such as departments of natural resources, forestry, water conservancy and construction are strengthened. A well-established all-region ecological and environmental big data resource system which is comprehensive and in accordance with unified standards was set up. And an intelligent remote sensing management platform for ecological environment of West Coast New Area was built.

Figure .1 Integrated Command Center - "Control Center + A map of Intelligent Environmental Protection + Visualization of Law Enforcement"

(2) Establishment of An Operational Application System

On the basis of the construction of ecological and environmental big data resource system, artificial intelligence and big data technology were taken full advantage of to build four operational application systems including bare land dust remote sensing management system, water environmental quality remote sensing detection system, air quality multi-mode forecast system and air quality management decision evaluation system.

① Bare Land Dust Remote Sensing Management System

It makes best use of satellite remote sensing data and combines with remote sensing intelligent interpretation technology to carry out AI horizontal scanning and analysis of bare land in the whole region according to monthly frequency, conduct all-region remote sensing detection, analysis, process management and display of bare land, and realize dynamic update through automatic change detection and analysis of multi-temporal remote sensing data. It provides support for studying the correlation between bare land dust and air pollution.

Figure .2 Comprehensive Index Control Center

② Water Environmental Quality Remote Sensing Detection System

Based on satellite remote sensing and ground detection data, and with the full use of artificial intelligence, big data and other advanced technologies, a remote sensing detection system for water environment quality is constructed to realize the normal remote sensing detection of human disturbance in the drinking water source protection areas, sewage discharge outlet into rivers and seas, and black and odorous water body in the new district, so as to ensure water ecological and environmental safety of the new district.

Figure .3 Comprehensive Index Control Center - Water Environment

③ Air Quality Multi-mode Forecast System

The air quality multi-mode forecast system is the technical core of air quality forecasting. Based on pollutant emission inventories and weather forecast data, the air quality numerical model is used to calculate and predict the concentrations of various pollutants in the air environment. Combined with forecast data post-processing system, the visual air quality forecast is provided, and a set of air quality prediction and early warning system with air quality numerical model at the core is established.

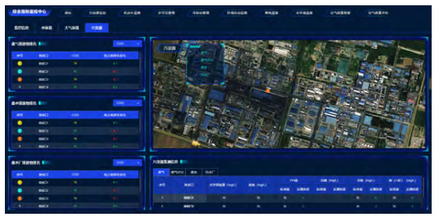


Figure .4 Comprehensive Index Control Center - Atmospheric Environment

④ Air Quality Management Decision Evaluation System

The air quality management decision evaluation system provides decision evaluation from areas of the sources of pollution files, emission inventory, air quality analysis, prediction and forecast, heavy pollution emergency response and others. Based on the analysis of the current situation, it carries out planning work including prediction, evaluation and meeting the standards, providing operational support for air quality management.

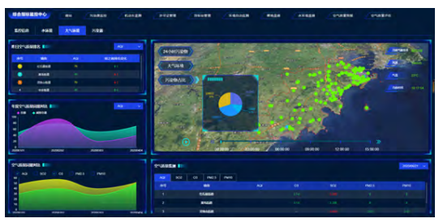


Figure .5 Comprehensive Index Control Center - Pollution Sources

Achievements

This project strengthens the application of remote sensing technology, artificial intelligence, big data, cloud computing, geographic information and other new technologies in ecological and environmental information construction. It implements all-round ecological examination of the water, soil and air in the whole West Coast New Area, and gets a clear picture of its ecological status. The overall perception of water environment, air environment and ecological and environmental changes is conducted through the all-rounded ecological and environmental monitoring, gradually improving the application of intelligent environmental monitoring and decision-making on air, water, ecosystem and so on. Ecological and environmental monitoring, early warning and scientific decision-making are made intelligent.

The project has the following advantages and applications of innovative technologies:

(1) The perception system of sky and earth integrated ecological and environmental protection has been built to realize the three-dimensional perception of the ecological environment.

(2) The multi-temporal satellite image object recognition and change monitoring technology with artificial intelligence deep learning technology as the basis can accelerate the interpretation on the premise of ensuring accuracy in the supervision of bare land dust, human disturbance in water source protection areas, and sewage outlet into river and sea, and the efficiency is more than 10 times higher than the conventional manual method.

(3) Cloud architecture based online ecological environment intelligent remote sensing supervision platform enables online access to services anytime and anywhere.

Enlightenment

The remote sensing team of SenseTime has created innovative "intelligent remote sensing +" applications in various fields such as marine protection, marine resources, natural resources, urban planning, ecological and environmental protection, and emergency and disaster reduction through the construction of the intelligent remote sensing management platform for ecological environment. It provides strong technical support for water, air and soil improvement as well as output of high-quality marine products in the West Coast New Area, accelerating the construction of a livable modern ecological city enabling citizens to live happily and the national new marine economic development zone.

· The Action Plan for Ecological and Geographical Environmental Protection and Sustainable Development of Quality Geographical Products

The Action Plan for Ecological and Geographical Environmental Protection and Sustainable Development of Quality Geographical Products

中国科学院地理科学与资源研究所
Institute of Geographic Sciences and
Natural Resources Research, CAS

Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences

15 LIFE ON LAND

Background

Ecological and geographical environmental protection and sustainable development are part of the core elements of the UN Sustainable Development Goals. China is a country with the richest geographic diversity in the world with its unique geographical tradition. Most of the green areas in China are still economically underdeveloped, and many have just been lifted out of poverty and are still at risk of falling back into poverty. How to achieve environmental protection while ensuring regional economic development, and how to protect green mountains while organically combining with golden mountains is an important issue that needs to be addressed immediately for the sustainable development of China at present.

China and dozens of countries around the world are engaged in international trade activities of high-quality geographical products (including those representing geographical indications, geographical features and geographical traditional products). The Institute of Geographic Sciences and Natural Resources Research, CAS, together with the Working Committee on Geographical Big Data of the Geographical Society of China and the UN Consultative Committees on Information and Technology of the Chinese Association for Science and Technology (CCIT), has launched the “the Action Plan for Ecological and Geographical Environmental Protection and Sustainable Development of Quality Geographical Products”, in order to promote the healthy live products from healthy ecological environment and the scientific integration of “green mountains” and “golden mountains”, and ensure the protection of quality geographical products and intellectual property rights. The plan is based on comprehensive, systematic and reliable dissemination of big data, which is an important guarantee for the implementation of the project.

Innovative Practices

From the perspective of geography, the philosophy of “green mountains” means protecting the original ecology of the geographic environment. Products indicating geographical features are an important way to protect geographic ecologically products by means of intellectual property protection. At present, the research on the protection of products indicating geographical features in China is mainly in intellectual property and business circles with the lack of geographic science, weak scientific communication and non-comprehensive system.

“The Action Plan for Ecological and Geographical Environmental Protection and Sustainable Development of Quality Geographical Products” mainly collects, stores, manages, calculates, analyzes, displays and describes the relevant geographic distribution data in the space of the whole or part of the earth’s surface layer (including the atmosphere) through the geographic information system (GIS), a very important spatial information system, with the support of computer hardware and software systems, to provide information support and services for related high-quality geographic products. The project actively promotes scientific technologies such as vegetation monitoring, meteorological monitoring, air quality monitoring, soil monitoring, water quality monitoring, and makes use of networking and data transmission technology to collect and wirelessly transmit data including wind speed, wind direction, temperature, humidity, air pressure, light, rainfall, soil temperature, soil moisture, PM2.5, PM10, vegetation visible light, vegetation near-infrared images in real time. With the help of artificial intelligence, Internet of Things, and cloud computing technologies, the system can automatically identify vegetation coverage, height and phenology in the cloud platform. The action plan is dedicated to the digital construction of geographic ecologically products to create “digital ecology”, driving the ecological logistics with digital data and knowledge dissemination, and driving the flow of tourism based on practical research and learning, and to create an ecological and geographical environmental protection and sustainable development projects based on science, integrating data, product, origin, brand and reputation, with the support of fund flow.

The Institute of Geographic Sciences and Natural Resources Research, CAS (IGSNRR) focuses on solving major scientific and technological problems concerning public welfare in the field of resources and environment, which is relevant to the overall situation of the country and constrains long-term development. IGSNRR has become an important scientific and technological force for ecological and geographical environmental protection and sustainable development of geographical products, by continuously improving its capacity for independent innovation and sustainable development. In 2016, it was approved as a full member of the World Data System (WDS) of the International Council for Science (ICSU), namely "World Data System—Global Change Research Data Publishing & Repository (WDS-GCdataPR)", as China Group on Earth Observations (China GEO) Data & Discovery Publishing Sub-Center by National Remote Sensing Center of China, the Ministry of Science and Technology, and as National Earth Observation Data Center Data & Discovery Publishing Sub-Center in 2019.

Achievements

"The Action Plan for Ecological and Geographical Environmental Protection and Sustainable Development of Quality Geographical Products" has integrated 5 cases in line with this theme, 3 alternative cases, 2 cases of instrument and equipment services and 1 case of investment consulting services. And the international and domestic registration of relevant intellectual property rights have been done.

Enlightenment

The 10-year project, "the Action Plan for Ecological and Geographical Environmental Protection and Sustainable Development of Quality Geographical Products" from 2021 to 2030, is to "enable every consumer to enjoy truly quality geographical products from green mountains, and every guardian of green mountains to be enriched by truly quality geographical products". The project will follow scientific empowerment of ecological environmental protection for geographical products and sustainable development led by scientific communication, so that the protection and sustainable development of ecological and geographical diversity in China can set an example in the world.

Postscript

This casebook contains 21 innovative practice cases based on 17 UN 2030 sustainable development goals from the engineering community. On the one hand, it shows the practical achievements of engineering innovations in promoting sustainable development so as to enhance exchanges and cooperation, and promote excellent practices and solutions; On the other hand, it aims to inspire colleagues in the engineering industry to think about their doings from the perspective of sustainable development.

In today's new era, while promoting great changes in economy and society, engineering itself is also undergoing profound changes. The extension of engineering is expanding rapidly. This subject not only explores how to create "artifacts", but also rapidly infiltrates into the economic system, ecosystem and social system. The global engineering development is entering a new round of transformation, and the renewal cycle of new discoveries, new technologies, new materials and new products is becoming shorter and shorter. At the same time, engineering is also facing many new challenges, including inequality in this field, imbalance in regional development, reform of engineering education and other challenges, as well as challenges related to the realization of sustainable development goals. The problems of sustainable development are often complicated, which require interdisciplinary, cross-national and cross-cultural engineering solutions. Therefore, in order to achieve the UN Sustainable Development Goals, global engineering needs to start transformative development, and changes should be more innovative, inclusive, cooperative and responsible.

This casebook is expected to function as an opening and a mobilization to mobilize the whole engineering circle to work together to promote the realization of global sustainable development!

In the process of compiling the casebook, the China Committee of the World Federation of Engineering Organizations and the WFEO Committee on Engineering for Innovative Technologies (CEIT) are responsible for compiling the content; China Association for Science and Technology, the Beijing Institution of Engineers (BIE), the Jiangsu Institution of Engineers, China Institute of New Generation Artificial Intelligence Development Strategies and Nankai University have provided important support for material collection, and various enterprises, universities and institutions have provided valuable case materials. The efforts of all parties are greatly appreciated.


SUSTAINABLE
DEVELOPMENT GOALS